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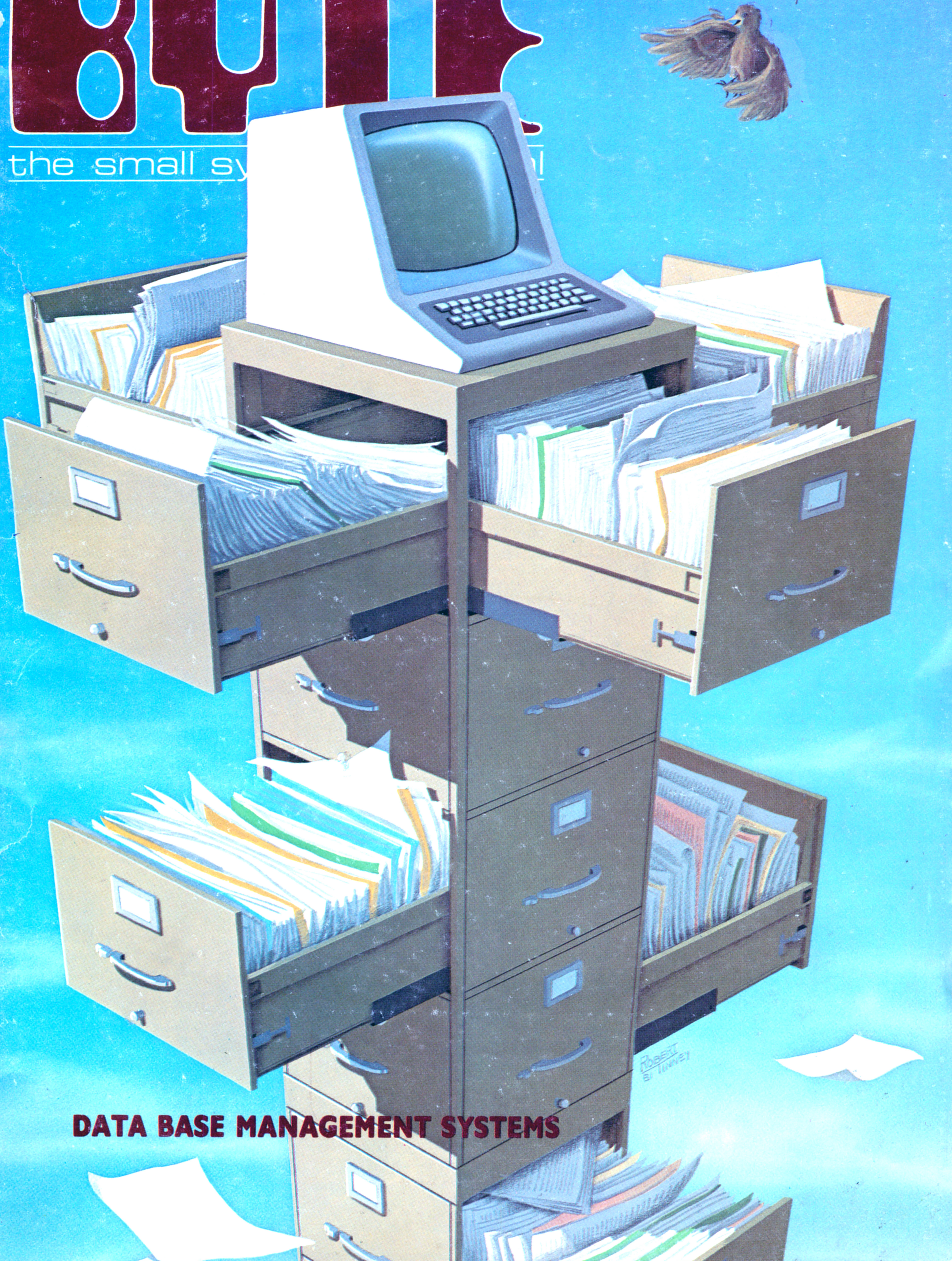
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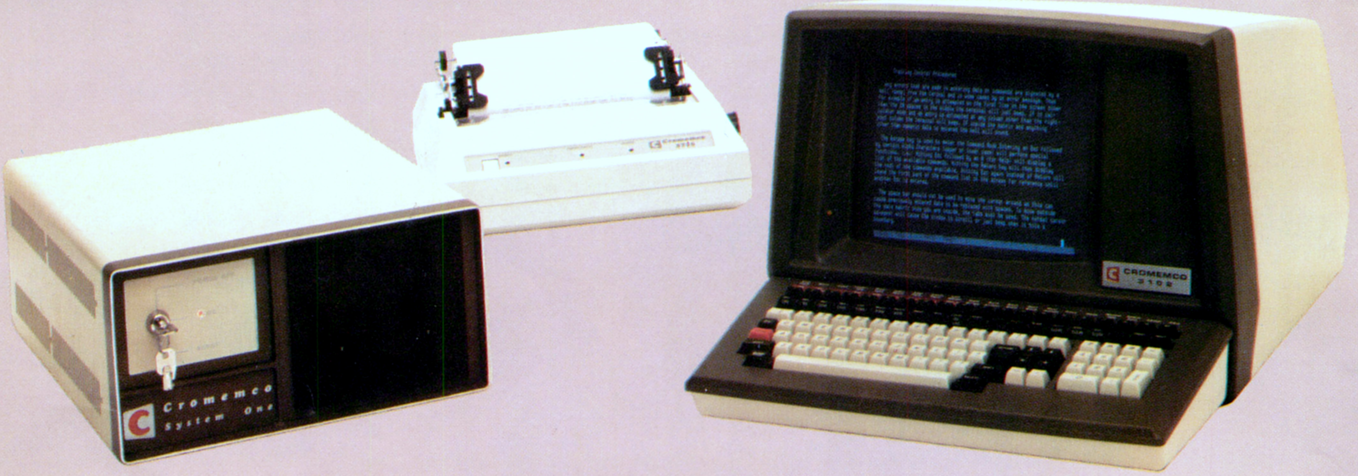
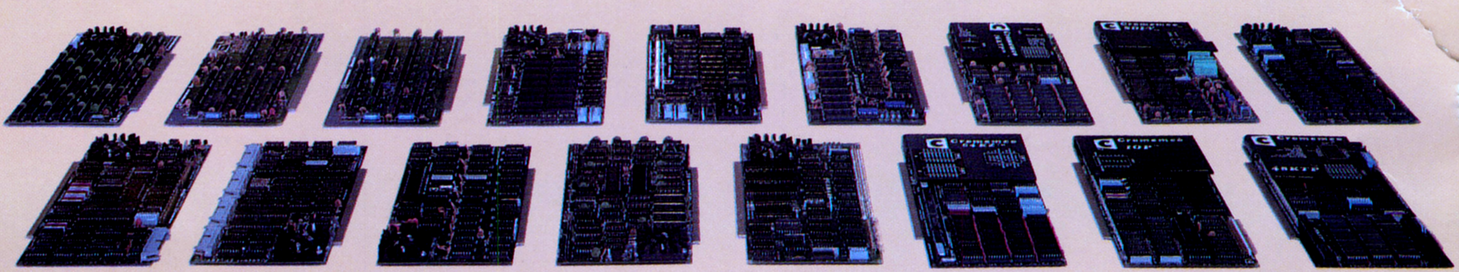
DATA BASE MANAGEMENT SYSTEMS

A new small computer that won't limit you tomorrow


Cromemco System One
CROMEMCO 3102

New Cromemco System One shown with our high-capability terminal and printer.



Expandability

Circle 118 on inquiry card.

Here's a low-priced computer that won't run out of memory capacity or expandability halfway through your project.

Typically, computer usage tends to grow, requiring more capability, more memory, more storage. Without a lot of capability and expandability, your computer can be obsolete from the start.

The new System One is a real building-block machine. It has capability and expandability by the carload.

Look at these features:

- **Z80-A processor**
- **64K of RAM**
- **780K of disk storage**
- **CRT and printer interfaces**
- **Eight S-100 card slots, allowing expansion with**
  - **— color graphics**
  - **— additional memory**
  - **— additional interfaces for telecommunications, data acquisition, etc.**
- **Small size**

GENEROUS DISK STORAGE

The 780K of disk storage in the System One Model CS-1 is much greater than what is typically available in small computers. But here, too, you have a choice since a second version, Model CS-1H, has a 5″ Winchester drive that gives you **5 megabytes** of disk storage.

MULTI-USER, MULTI-TASKING CAPABILITY

Believe it or not, this new computer even offers multi-user capability when used with our advanced CROMIX* operating system option. Not only does this outstanding O/S support multiple users on this computer but does so with powerful features like multiple directories, file protection and record level lock. CROMIX lets you run multiple jobs as well.

In addition to our highly-acclaimed CROMIX, there is our CDOS*. This is an enhanced CP/M† type system designed for single-user applications. CP/M and a wealth of CP/M-compatible software are also available for the new System One through third-party vendors.

COLOR GRAPHICS/WORD PROCESSING

This small computer even gives you the option of outstanding high-resolution color graphics with our Model SDI interface and two-port RAM cards.

Then there's our tremendously wide range of Cromemco software including packages for word processing, business, and much more, all usable with the new System One.

ANTI-OBSOLESCENCE/LOW-PRICED

As you can see, the new One offers you a lot of performance. It's obviously designed with anti-obsolescence in mind.

What's more, it's priced at only $3,995. That's considerably less than many machines with much less capability. And it's not that much more than many machines that have little or nothing in the way of expandability.

Physically, the One is small — 7″ high. And it's all-metal in construction. It's only 14⅛″ wide, ideal for desk top use. A rack mount option is also available.

CONTACT YOUR REP NOW

Get all the details on this important building-block computer. Get in touch with your Cromemco rep now. He'll show you how the new System One can grow with your task.

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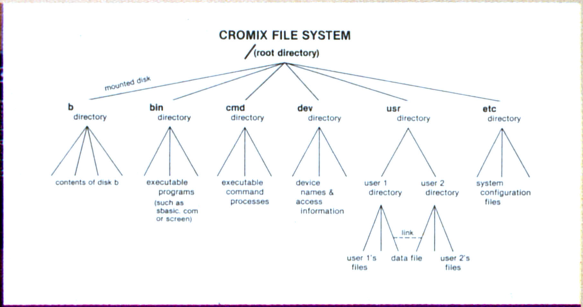
CROMIX FILE SYSTEM
/(root directory)
mounted disk
b directory
bin directory
cmd directory
dev directory
usr directory
etc directory
contents of disk b
executable programs (such as sbasic. com or screen)
executable command processes
device names & access information
user 1 directory
user 2 directory
system configuration files
link
user 1's files
data file
user 2's files

CROMIX
Cromemco Diskette

CROMIX*—Cromemco's outstanding UNIX†–like operating system

CROMIX is just the kind of major development you've come to expect from Cromemco. After all, we're already well-known for the most respected software in the microcomputer field.

And now we've come up with the industry's first UNIX-lookalike for microcomputers. It's a tried and proven operating system. It's available on both 5'' and 8'' diskettes for Cromemco systems with 128K or more of memory.

Here are just some of the features you get in this powerful Cromemco system:

- Multi-user and multi-tasking capability
- Hierarchical directories
- Completely compatible file, device, and interprocess I/O
- Extensive subsystem support

FILE SYSTEM

One of the important features of our CROMIX is its file system comprised of hierarchical directories. It's a tree structure of three types of files: data files, directories, and device files. File, device, and interprocess I/O are compatible among these file types (input and output may be redirected interchangeably from and to any source or destination).

The tree structure allows different directories to be maintained for different users or functions with no chance of conflict.

PROTECTED FILES

Because of the hierarchical structure of the file system, CROMIX maintains separate ownership of every file and directory. All files can thus be protected from access by other users of the system. In fact, each file is protected by **four separate access privileges** in each of the three user categories.

TREMENDOUS ADDRESS SPACE, FAST ACCESS

The flexible file system and generalized disk structure of CROMIX give a disk address space in excess of one gigabyte per volume — file size is limited only by available disk capacity.

Speed of access to disk files has also been optimized. Average access speeds far surpass any yet implemented on microcomputers.

'C' COMPILER AVAILABLE, TOO

Cromemco offers a wide range of languages that operate under CROMIX. These include a high-level command process language and extensive subsystem support such as COBOL, FORTRAN IV, RATFOR, LISP, and 32K and 16K BASICs.

There is even our highly-acclaimed 'C' compiler which allows a programmer fingertip access to CROMIX system calls.

THE STANDARD O-S FOR THE FUTURE

The power and breadth of its features make CROMIX the standard for the next generation of microcomputer operating systems.

And yet it is available for a surprisingly low $595.

The thing to do is to get all this capability working for you now. Get in touch with your Cromemco rep today.

---

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November 1981

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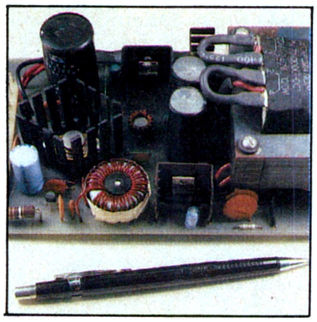
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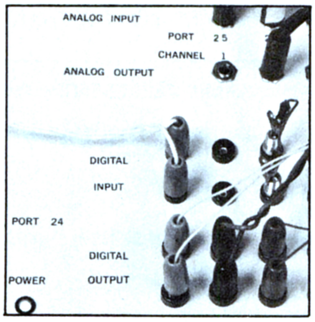

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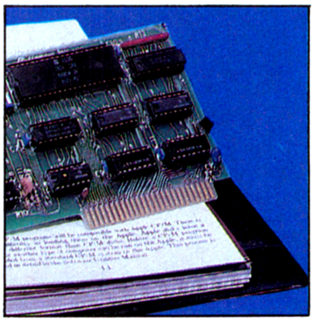
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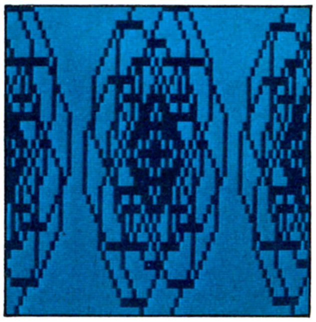
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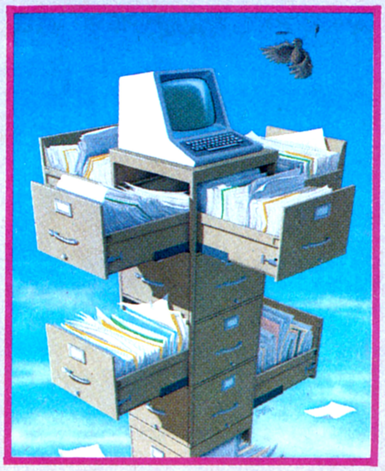

In This Issue

Office workers who bravely face that ever-growing mountain of paper will tell you that keeping track of information becomes more difficult daily. How to impose order? As Robert Tinney's cover suggests, the answer is something like an electronic file cabinet.

This month's theme concerns the problems of data management. Joel Neely and Steve Stewart will get you started with "Fundamentals of Relational Data Organization." From there you can move on to "Data-Base Management Systems: Powerful Newcomers to Microcomputers," "A Survey of Data-Base Management Systems for Microcomputers," and "PDQ: A Data Manager for Beginners." "DIF: A Format for Data Exchange between Applications Programs" presents a strong argument for standardization of data formats. Apple II file-management systems are reviewed. And you can learn how to write with your data-base management system. Is spelling a nightmare? If so, you'll be interested in Phil Lemmons' review of the five major CP/M spelling-correction programs. Of course, there's Ciarcia's Circuit Cellar, BYTELINES, and our other regular features, too.

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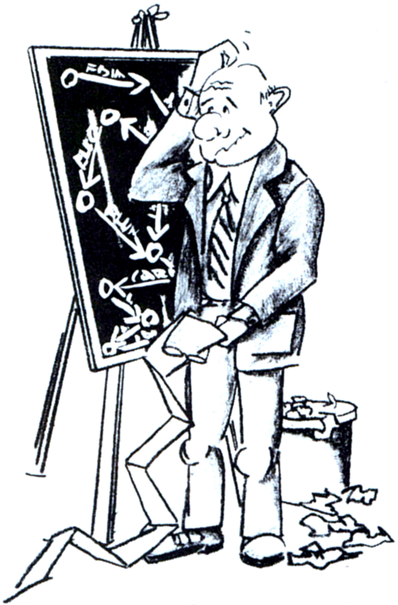

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Editorial

Can We Agree on Standards?

by Chris Morgan, Editor in Chief

Recipe for a heated debate:

- *Put two or more personal computer users in a room.*
- *Ask them to agree on a hardware or software standard.*
- *Stand back.*

Somewhat cynical? Perhaps, but the mere mention of a proposed standard often raises a whole crop of hackles. I suspect there are several reasons for this attitude: computer scientists are notoriously individualistic (not to say curmudgeonly); we are often reactionary because of our inbred love of ritual (if you doubt this, ask any psychologist who has studied computer people); and, perhaps most important, many personal computer industry standards are lacking in many ways.

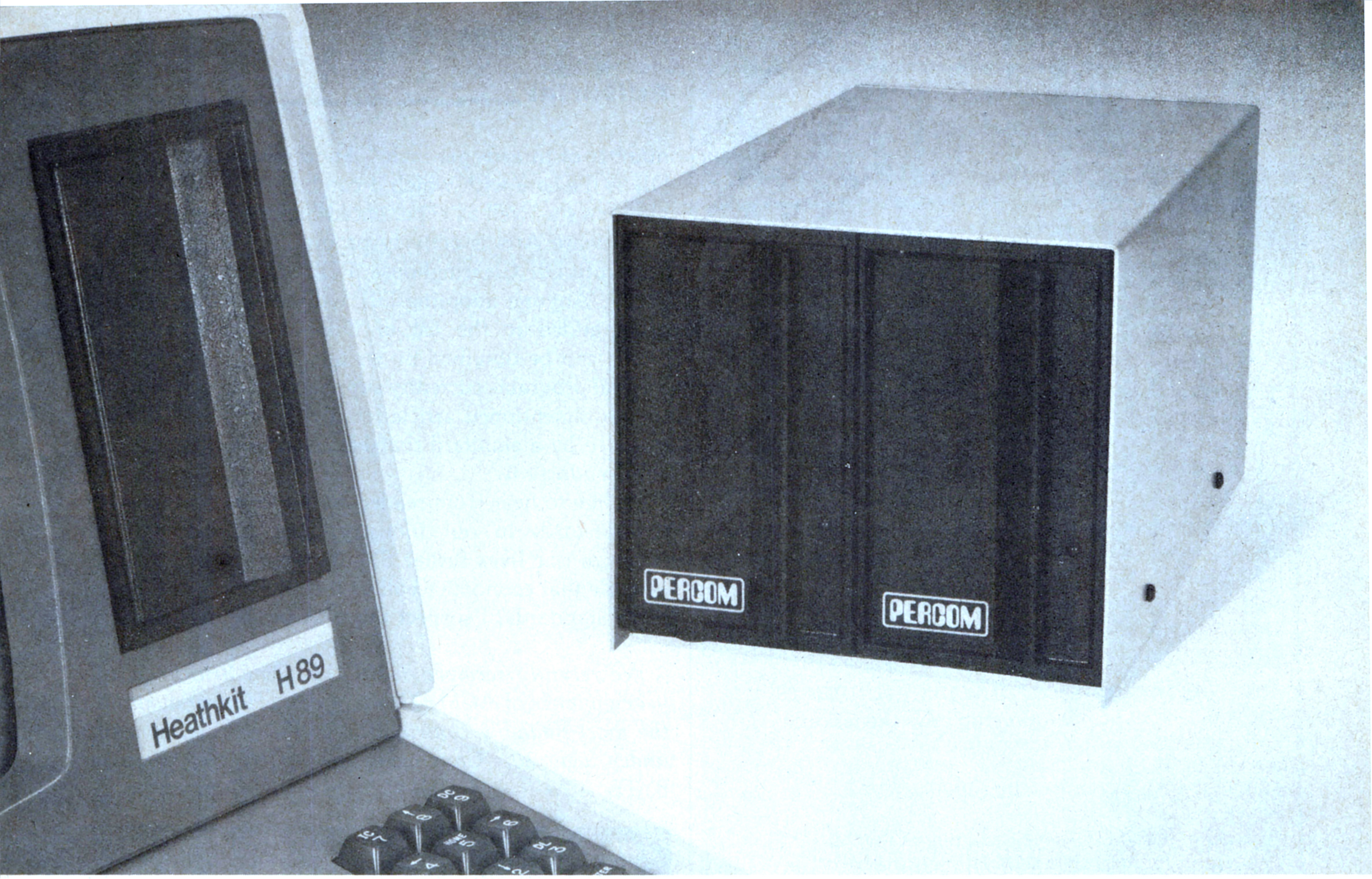
For example, we seem to have been poured into the BASIC mold, like it or not. (Although, ironically, BASIC is possibly the *least* standardized of the high-level languages.) One hundred ten baud is not exactly Mach 1. Standard television receivers leave much to be desired. The S-100 bus has only recently become a serious hardware standard, thanks mostly to the Institute of Electrical and Electronics Engineers (IEEE).

I remember the day when, fresh from seven years as an aerospace electronics engineer, I entered the BYTE offices and first saw an S-100 board. I was appalled at the number of connector pins—a design approach anathema to anyone whose circuits have to survive the vibrations of a moving aircraft. There simply was no excuse for putting 100 pins on a printed-circuit board when half that number would do.

Today I know that, far from being a disaster, the S-100 standard has proved its worth (although I *still* wouldn't want an S-100-based computer in the cockpit of a plane). So I guess I'm a bit of a curmudgeon myself. In fact, I've been known to take inordinate delight in approaching a group of good-natured hackers at a computer convention and innocently expressing my preference for BASIC over APL as "much the superior language," or the like. The resulting debate is often enough to activate nearby smoke detectors.

But returning to the question of standards, I want to bring to your attention a standard that just about everyone should like: it's called DIF (for Data Interchange Format). DIF was developed by Dan Bricklin and Bob Frankston at Software Arts (the developers of VisiCalc), aided by Mitch Kapor, inventor of VisiPlot. It's comprehensively described this month in an article called "DIF: A Format for Data Exchange between Applications Programs," by Candace E Kalish and Malinda F Mayer, on page 174. Briefly, DIF is a standard method for representing data in a program so that it can be transported directly to other programs, without time-consuming modifications. For example, a VisiCalc user might want to plot some calculated data using VisiPlot. (In fact, this is why DIF was initially developed.) Since both programs accept the DIF standard, the process becomes quick and straightforward.

As Bricklin explains it, "If you're building a box with pipes going in and out of it, it would be nice if there were one pipe that you knew other boxes could connect to. With DIF, we essentially define the diameter of that pipe and the



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Percom's double-density Z Controller for the H-89 is now available.

Check its many outstanding features.

And keep in mind its from Percom, a company that introduced its first disk system in 1977.

● Controls up to four single- or double-headed mini-disk drives. ● Handles 35-, 40-, 77- and 80-track drives, and other standard track densities. ● Formatted data storage capacity of 80-track diskettes is over 368 Kbytes. Forty-track diskettes store over 184 Kbytes. Capacities for other track densities are proportional. A Z system with four double-headed, 80-track drives provides almost 3 megabytes of on-line data. ● The Z Controller co-resides with your H-89 disk drive controller. Your software can select either, and you don't have to move drives around when switching between systems. ● The Z Controller includes Percom's proven digital data separator circuit and a dependable write-precompensation circuit. Expect reliable disk operation for a long, long time under 'Z' control. ● The Percom Z Controller is priced at only $249.95, complete with HDOS-compatible disk drivers on diskette, internal interconnecting cable and comprehensive users manual.

System requirements – H-89 Computer with 24 Kbytes memory (min), Replacement ROM Kit H-88-7 and HDOS 2.0.

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System requirements – H-89 or H-8 computer with 16-Kbyte RAM, Heath first-drive floppy disk system, HDOS and drives interconnecting cable. (Two-drive interconnecting cable optionally available from Percom)

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number of threads per inch." Another positive feature of DIF is the ease with which it can be used by novice programmers as well as experienced hackers.

Software Arts is actively promoting DIF through the nonprofit DIF Clearinghouse, POB 527, Cambridge MA 02139. Anyone adopting DIF will have his or her program added to the list of DIF-compatible programs, which can be obtained by writing to the clearinghouse. Several programs currently support the DIF standard (see the aforementioned article for a complete list). DIF appears to be a standard that has everything going for it, and I endorse it.

I'd like to hear from readers about the whole question of standards in our industry. Are our attempts to organize our lives futile? Should we even try? Is it inevitable that economics will be the lone arbiter of tomorrow's standards? I suspect this may be the case.■

We recently received word that Dan Bricklin is this year's winner of ACM's Grace Murray Hopper award for the most valuable contribution to the field by someone under age 30. Congratulations from all of us at BYTE...**CM**

Articles Policy

BYTE is continually seeking quality manuscripts written by individuals who are applying personal computer systems, designing such systems, or who have knowledge which will prove useful to our readers. For a more formal description of procedures and requirements, potential authors should send a large (9 by 12 inch, 30.5 by 22.8 cm), self-addressed envelope, with 28 cents US postage affixed, to BYTE Author's Guide, POB 372, Hancock NH 03449.

Articles which are accepted are purchased with a rate of up to $50 per magazine page, based on technical quality and suitability for BYTE's readership. Each month, the authors of the two leading articles in the reader poll (BYTE's Ongoing Monitor Box or "BOMB") are presented with bonus checks of $100 and $50. Unsolicited materials should be accompanied by full name and address, as well as return postage.

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Tandy Corporation has arranged to use Datapoint Corporation's Attached Resource Computer (ARC) technology, software, and protocols for a high-speed TRS-80 Model II local network. Called ARCNET, the new network will let up to 255 Model IIs share peripherals and data bases. ARCNET can include Datapoint file processors, computers, printers, and 137-megabyte hard disks. For an ARCNET network, you will need a $400 board, which Tandy will sell and install, plus RG-62 coaxial cable and junction boxes to link the computers. One in four Model IIs on the network will function as a file processor.

Since Model IIs on the ARCNET network can share access to a large hard disk, there will be a version of the machine without a built-in floppy disk. Future Tandy computers will be ARCNET-compatible. Tandy will not adapt the TRS-80 Model III for the network, citing different screen parameters and operation speeds as the reason.■

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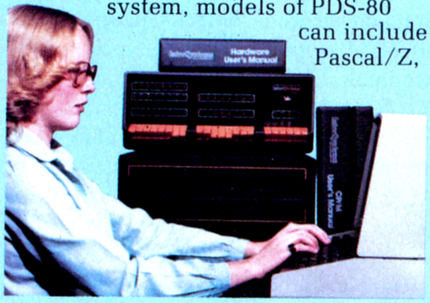

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Letters

Music Board Draws Criticism

Having read Rob Moore's article "Mountain Computer's MusicSystem" (see the July 1981 BYTE, page 60), I feel I must comment on some of the technical errors that give an incorrect impression of other synthesizers available for the Apple, particularly since our ALF synthesizers are mentioned several times in the article.

First, Mr Moore has an incorrect impression of the definition of "synthesizer." Contrary to his statements, all music cards available for the Apple that I'm aware of are truly synthesizers, not just Mountain Computer's. A "music synthesizer" is simply a device that creates music by "synthesis," i.e., by control of two or more parameters (each of which is only part of a sound) to produce a complete sound of the desired nature. Mr Moore seems to think that an ability to imitate conventional instruments is necessary in a synthesizer, but such is not the case. Actually, no synthesizer available for the Apple (and, for that matter, virtually no synthesizer of any sort) can imitate conventional instruments. Only Mountain Computer claims to be able to do this. A few moments of listening will convince anyone that the claim is advertising "hype": the unit simply cannot imitate most instruments well enough to fool even the moderately careful listener, much less someone very familiar with the instrument being imitated. Responsible companies make no such claim; the goal of synthesizers is to create music that sounds good and has sufficient variety, not to duplicate a conventional instrument's sounds exactly.

Mr Moore places the Mountain Computer synthesizer in the same class with Moog and ARP synthesizers, although they are almost totally different (the Mountain Computer unit, for example, uses additive synthesis and the Moog and ARP units are almost exclusively subtractive synthesis). Then he degrades the attack-decay-sustain-release method used on the ALF units, although this method is identical to the envelopes used on the expensive Moog and ARP. He specifically mentions that this method is difficult to use for piano-like envelopes, since they decay during sustain. This is incorrect. The fact that a piano decays during sustain simply means that the sustain level should be adjusted to zero and a very slow decay rate used. The abrupt drop upon key release is, of course, managed with a fast release rate setting.

In the realm of music notation, Mr Moore claims that music printed by the PRINT command can be cut and pasted to form an orchestral score. This, too, is incorrect. In an orchestral score (acutally "full score"), the measure bars will line up from part to part; the PRINT command does not adjust the music printout as it would be in a typical musical score. In fact, the PRINT command output is missing so many music features, notably beaming of notes shorter than quarter notes, that to an untrained eye it might not even resemble the original score, even if the various parts *are* pasted together.

Mr Moore also fails to understand the limits of the Apple's processor, except when discussing the particularly difficult case of software-driven D/A (digital-to-analog) synthesis. He mentions that three ALF 3-voice cards can be used for nine voices, which is true, but he states that an advantage of this card is that more voices can be added simply by using additional cards. If this were true, why not use four cards for twelve voices? In fact, the Apple processor is pressed to keep up with the nine voices. The processor-speed limitation affects every parameter controlled by the software. If the Apple were twice as fast, we would be able to have envelopes on the ALF card that were twice as smooth, which would result in a greater variety of sounds due to increased resolution and accurate control. The speed limit affects all synthesizers of all types, but the Mountain Computer system is particularly affected because the computer runs only at half speed during playback. Add the burden of 16 voices, compared to ALF's conservative nine, and you'll surely realize the Mountain Computer's software-controlled parameters (such as frequency and amplitude envelopes) must be very coarse indeed. In turn, this limits the variety of sounds available.

Mr Moore's statement that square-wave synthesizers have invariably sharp high notes and buzzy-sounding low notes is incorrect. Using Fourier analysis, which he describes on page 78, one can see that the harmonic contents of high and low notes are identical. The process he calls additive synthesis (used to create different sounds) can be done on every synthesizer available for the Apple, not just the Mountain Computer system. It is important to note that additive synthesis can be used only to *add* harmonics. Therefore, a square-wave synthesizer, already rich in harmonics, cannot produce low harmonic sounds using additive synthesis. By using very detailed and rapid envelopes on several channels, extremely complex and interesting sounds can be created. Because the Mountain Computer unit cannot produce very short notes (due to processor limitations I mentioned) and because it does not have a subroutine capability (which is essential, especially for echo/reverb effects), it cannot produce the types of sounds that are available on the square-wave units.

The greatest injustice done to the various competing cards lies in the text box "Music Making" on page 84 and in Moore's conclusions. He virtually declares that all other systems have advantages and disadvantages, but the Mountain Computer system has the best of everything. Each unit has its own best and worst factors. True, the Mountain Computer unit has a price of $545 and a full-blown ALF AMS system is $735 (not $795 as quoted in the article), but the ALF MC1 has as many voices as that full-blown system and costs only $195 (not to mention having all the goodies that on page 92 he wishes the Mountain Computer system had). As one might expect, these differently priced systems offer different types of performance. Despite Mr Moore's claims, the Mountain Computer system is definitely not the most powerful synthesizer available for the Apple II—no particular unit is.

Finally, it might be nice for readers to have our address and phone number. Rob Moore gives the phone number and address of every company he mentions except ALF. Our phone number is (303) 234-0871.

Philip J Tubb
ALF Products Inc
1448 Estes
Denver CO 80215

Rob Moore Replies:

I must concede Phil Tubb's point that any device that allows control of two or more musical parameters can accurately be called a synthesizer. According to his definition, however, the Apple's speaker, with its control of frequency and volume (on or off), is also a synthesizer. But I do not know of any "professional-quality"

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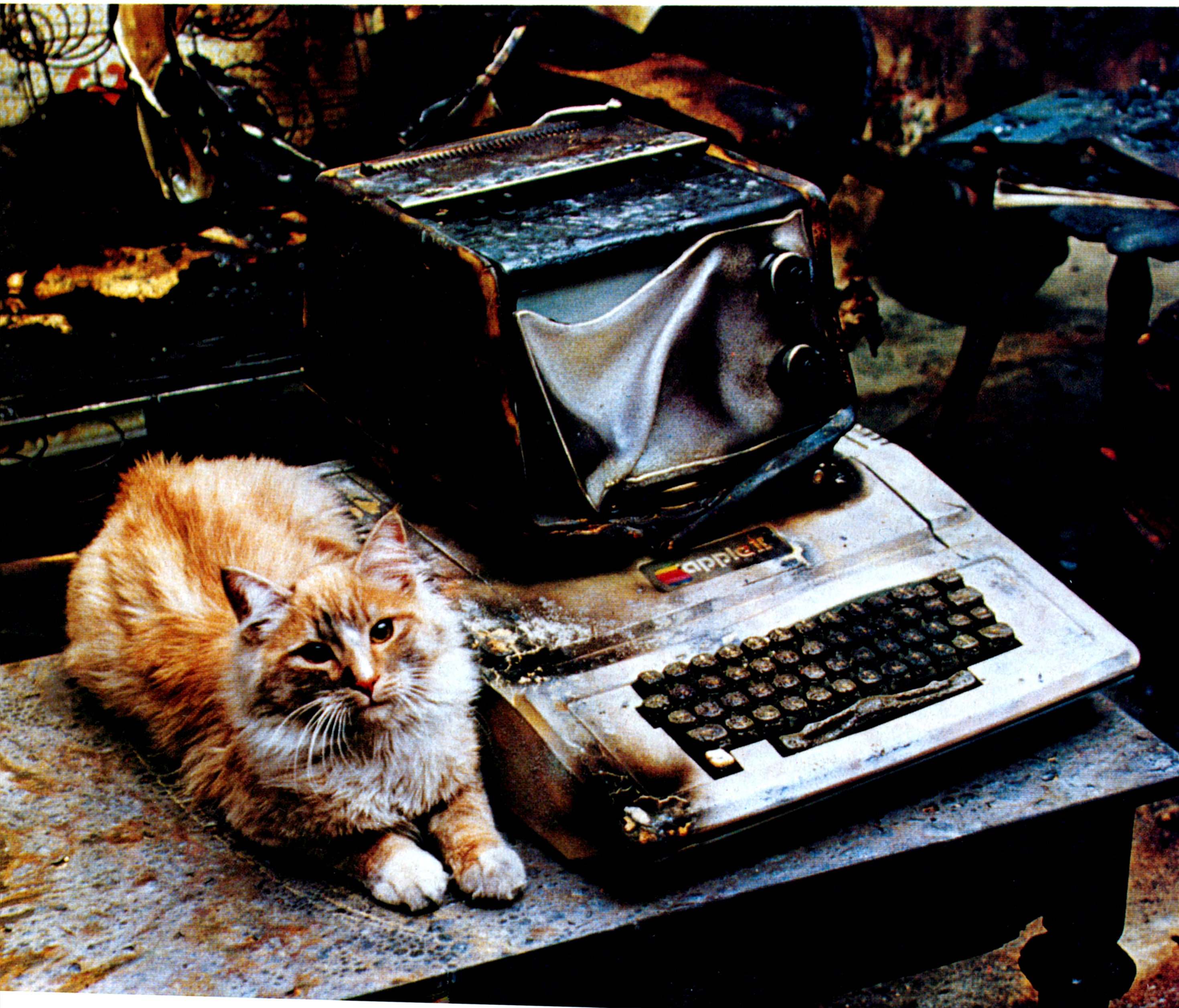

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Circle 29 on inquiry card.

synthesizer that does not offer some degree of waveform control, whether it is Moog, ARP, Synclavier, or even Radio Shack's new Moog unit.

In my article, I did not say that a synthesizer must be able to imitate real instruments. In fact, a synthesizer with control of a reasonable number of parameters will be able to produce recognizable instrument sounds as a by-product of its flexibility in sound production.

Mr Tubb has also apparently confused the meanings of the words imitate, simulate, *and* duplicate. *Neither I, nor Mountain Computer, claim that the MusicSystem can duplicate the sound of real instruments; however, it can produce recognizable simulations (or imitations) of a number of conventional instruments. This is an ability that is usually attractive to newcomers who have not had much experience with music synthesis, but who might enjoy simulating the sounds of familiar instruments.*

Mr Tubb is correct in his comments about the MusicSystem's PRINT command. Yet, that is why I referred to its output, when cut and pasted, as a ". . . sort-of-orchestral . . ." score. While unconventional, the result is still useful.

I'm afraid that it is Mr Tubb who fails to understand the capabilities of the Apple's 6502 microprocessor. If the 6502 is fast enough to generate D/A music, sampling four parts at 8 kHz each, then it certainly has the speed to sample 16 envelopes at several hundred samples per second. As a matter of fact, the MusicSystem's 8 ms envelope-sample period falls near the beginning of the 5 to 20 ms range of periods typically found in systems of this type. His comment that the envelopes must be very coarse in a 16-voice system (while smooth with the ALF's "conservative" nine voices) has no basis in fact. It sounds as though he is trying to say that "less is more"—that nine square-wave voices are somehow better at producing music than 16 variable waveform voices.

I stand by the statement that square-wave-only systems invariably have bright, sharp high notes and buzzy-sounding lows. *Although both high- and low-frequency square waves have the same harmonic content, they do not have the same mix of frequencies. Additionally, the human ear's response drops off quite fast at low frequencies, so when a low-frequency square wave is played, the listener hears proportionally more of the high-frequency components—thus, the "buzzy" sound.*

Regarding additive synthesis: Just as Fourier analysis decomposes a waveform into its simplest component parts (i.e., sine waves with frequencies that are integer multiples of the note's fundamental frequency), Fourier synthesis is used to construct a waveform from these same components. Although additive synthesis is often used as a synonym for Fourier synthesis, it may also consist of adding various arbitrary waveforms to synthesize the final result. But I cannot agree that a fixed-waveform music device can accomplish additive synthesis. Certainly some interesting and sometimes pleasant sounds can be produced, but rapid envelope variations are not the same as additive synthesis.

Mr Tubb is correct when he mentions, as I did in the article, that the Mountain Computer MusicSystem has no musical subroutine capability, while the ALF does. Fortunately, this is only a software limitation that will be corrected in the next software release and not a hardware limitation.

I do not believe that any injustice was done in the "Music Making" textbox in the article. When products of any sort are produced to meet specific cost goals, various trade-offs have to be made to stay within those limits. Inevitably, the trade-offs vary and different products will have their own strengths and weaknesses. Also, as electronic technology advances, prices will come down and allow features to be included that might have been too expensive a few years ago.

Mr Tubb also manages to confuse the terms most powerful *and* best. *The MusicSystem is the most powerful synthesizer currently available for the Apple II. It offers more voices and control of more musical parameters than any of the others. It is also relatively expensive and a bit more difficult to use than some of the lower-cost units. This is not to say that it is always the best choice for a given individual. The best choice is the unit that fits within the user's budget and offers the most acceptable combination of features.*

I'm sure that many people will find the ALF MC1 to be a good choice. With its nine voices and the excellent ALF software, the MC1 is a very good value.

DUE TO A PRINTING ERROR, the PerCom Heath Zenith ad on page 15 of the October issue should have been the PerCom ad for the TRS-80 drive systems. We apologize for any inconvenience this may have caused our readers.

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If the buyer can afford $545 or so, he or she should consider the MusicSystem. While its software could be improved in some areas, the MusicSystem's capabilities cannot be duplicated at this time.

An experimenter who wants to learn computer music from the inside out could take advantage of the excellent and inexpensive D/A music products offered by Micro-Technology Unlimited if he or she is willing to do some of the software work.

There are also a number of other inexpensive music cards—I have not tried them all. In short, there is no single system best for everyone. I suggest that readers go to a store and try out as many as possible and let their ears and budget decide.

I apologize for the inadvertent omission of ALF's address.

Mountain Computer Responds:

While the overall tone of Mr Philip Tubb's letter is extremely patronizing toward his own product and critical toward ours, I must say that Rob Moore's fine rebuttal covers many of the complaints that we would have in that particular category. There are one or two technical points that I will elaborate on here.

Our use of envelope control is one that represents a true envelope and how it actually occurs in an instrument, rather than in a conventionally synthesized method. This allows for the proper length and decay factors giving a more natural sound. Mr Tubb also fails to mention that his system cannot print any scores.

Another point that he brings out is that the computer runs at half speed on playback. While this is true, it is not a drawback because we can use the DMA capabilities of our system to our advantage. We service 16 voices without the information for the waveforms because the board has integrated intelligence. It can produce enough information for itself and the 16 voices simultaneously without the need for the Apple's 6502 processor's time. The ALF board, on the other hand, must be tied to the 6502 processor, continually using it to service the 9 voices and the envelopes. In short, we have very fine resolution on our waveforms and envelope controls, and ALF only has the envelope at a very low resolution point.

Additionally, the 9 voices (and that's only with three boards) are still not equal to or as versatile—that is the word Mr Moore used—as the Mountain Computer system. Without any argument on any other manufacturer's part, you will find the most capable and versatile system to be the Mountain Computer system.

Kent C Greenough, Director of Sales
Mountain Computer Inc
300 El Pueblo Rd
Scotts Valley CA 95066

A Little Ada Clarification

Having read "BYTELines" in the August 1981 BYTE (page 224) and having received several phone calls as a result of the article "Ada and Little Ada Released," I am prompted to write and clarify what may be a bit of a confusion.

TeleSoftware is wholly owned by a company called *TeleSoft*. TeleSoft does indeed have the first commercially available Ada compiler. It's called TeleSoft-Ada.

The juxtaposition of TeleSoftware's implementation of Ada and some information about "Little Ada" was unfortunate. There is absolutely no connection between TeleSoft-Ada and Little Ada.

Perhaps the confusion has arisen because only one address was printed at the end of the article, not ours!

Peter Dine, President
TeleSoft
10639 Roselle St
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Setting the Record Straight

In the August BYTE, our MultI/OS for 8080 and Z80 systems was mentioned in "BYTELines." BYTE incorrectly stated that "like the others, it also maintains CP/M compatibility." We are not similar to the others, they are similar to us! InfoSoft has been the trailblazer in CP/M compatibility since we created the game with CDOS. Everyone else is trying to catch up to us. MultI/OS is a new product based on our single-user I/OS that has been around for more than four years. We have maintained CP/M compatibility for just as long.

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Writing with a Data-Base Management System

Edward E Brent Jr, PhD
The Idea Works Inc
506 South Garth
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Nearly every microcomputer user appreciates the benefits of writing with a word-processing program. Pencil, paper, and typewriter can't match keyboard, video display, and line printer for speedy writing, editing, and printing of almost any kind of copy.

But word processing works best at relatively late stages in the writing process—after you've recorded your research results, compiled references, and constructed an outline for the project. In this article I show how another type of program, the data-base management system, can help you in the earlier stages of your writing. In fact, such a system can be *more* powerful than a word-processing program when you must perform a major reorganization of your text.

I first identify the stages of the writing process where a data-base management system (DBMS) can be most useful. Then I discuss the capabilities of such systems, detail their benefits, and recommend strategies for using the DBMS to maximum advantage.

About the Author

Edward Brent is assistant professor of sociology and family and community medicine at the University of Missouri in Columbia. He is also president of The Idea Works Inc, a research and consulting firm specializing in computer applications in research and design.

Although everyone has a favorite writing strategy, the process of writing can be broken down into several basic steps. After selecting a topic, the writer takes notes on ideas he may want to include. Next he outlines the article by organizing ideas and selecting a manner of presentation. The outline serves as a guide for composing the text, which is then revised until it satisfies the writer.

Limitations of Word Processing

When it comes to composing text, correcting it, and printing it out in an acceptable form, word-processing programs provide obvious advantages. But such programs lend themselves less well to note taking, outlining, and making major revisions. For these tasks, a DBMS can save time and energy.

When taking notes, you need a mechanism for recording ideas so that they will be easily accessible later. Note taking also calls for a system to minimize effort without distracting you from the task at hand. Both note taking and outlining involve only small amounts of text—text that's rough and tentative at best. Word-processing programs don't deal well with text in this form.

At the revision stage, word-processing programs do an efficient job with minor changes. But if you must add many new ideas, delete many old ones, or drastically change the logic of your presentation, you may be better off with a DBMS.

DBMS Characteristics

To understand how a computerized data-base system can help you write, you must first understand its characteristics. A generalized DBMS is a set of related programs that allows you to enter a wide variety of data into a computer *file*, organize it for storage, then retrieve, update, reorganize, and print it out in the form of a summary report. Each file, a collection of related data, can contain almost any type of information you desire, so long as it meets the minimal structural requirements of the DBMS.

File Structure. Before entering any data into a file, you must first define the file structure. Files consist of a number of *records*, each containing similar information and referred to by a unique number or keyword. In writing, each record might contain a note on a particular idea, or a point made in another book or article to be cited in the paper. A record is a collection of *fields*, each having a name, length and position. Within each field are data describing each aspect of a record. Field names such as "title"

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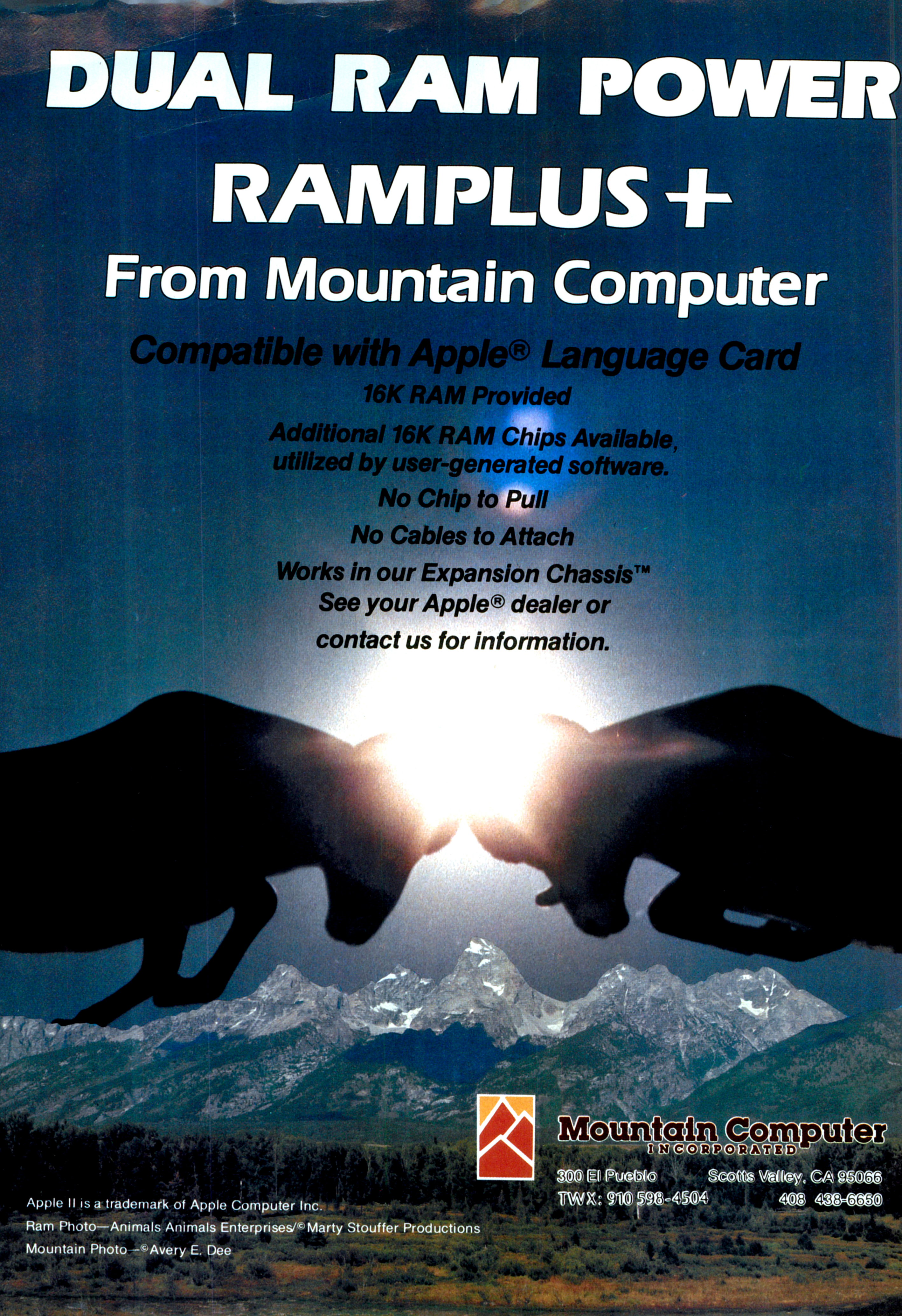

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and "author" identify the type of information stored in each field. The DBMS uses the length and position of the field to retrieve specific information.

Capabilities. Typical data-base management programs can perform a number of operations, including defining or creating a file; adding, modifying or deleting records; sorting the file according to some specific field; searching the file for records with certain values; and generating reports. You can store the data base created by these programs on a disk for future reference, and you can update it as your work on the paper progresses. Most data-entry programs prompt the user for relevant information and check to see that input data meet specified criteria. Others have sophisticated "query" languages that can perform arithmetic or Boolean algebraic manipulations on data in various fields. After computing percentages, totals, or other summary data, the program can store the data in another field or print it out. In essence, the DBMS is an electronic filing cabinet, storing information in various records and accessing and retrieving that information on command. Any particular record can be cross-indexed on many different key variables at the same time, and retrieved based on the value of those keys.

In microcomputers, a common method of sorting and retrieval used by the DBMS is the indexed sequential-access method (ISAM). This method uses a sequential access file to store the records as they are entered. An index is then created for that file, ordered by the values in the key field. The index is a table containing the key and the machine address of the record associated with each key. Records in the file may then be used according to their keys. The ISAM method provides the advantage of fast retrieval time.

Figures 1a, 1b, and 1c present a typical data base in terms of file structure, report format, and sample data records. These records are part of an extensive data base I used in writing this paper. In the TEXT field, each record contains a topic covered in this paper. A number of additional fields are used to take advantage of the capabilities of the DBMS to sort, search, and retrieve information. The characteristics of this data set are not particularly unusual, and you could use a similar strategy with many data-base management programs now available for microcomputers. The following sections discuss the advantages of the DBMS at each stage of writing.

Note Taking

If you can type, a DBMS can provide a fast and convenient means of recording notes. These may include quotes, summary notes referring to other sources, or your own ideas. A DBMS can be especially helpful when you spend a long time taking notes and then wait a while before actually drafting the paper. It is important to have some mechanism for recording ideas or references as they occur and then retrieving them later, when the

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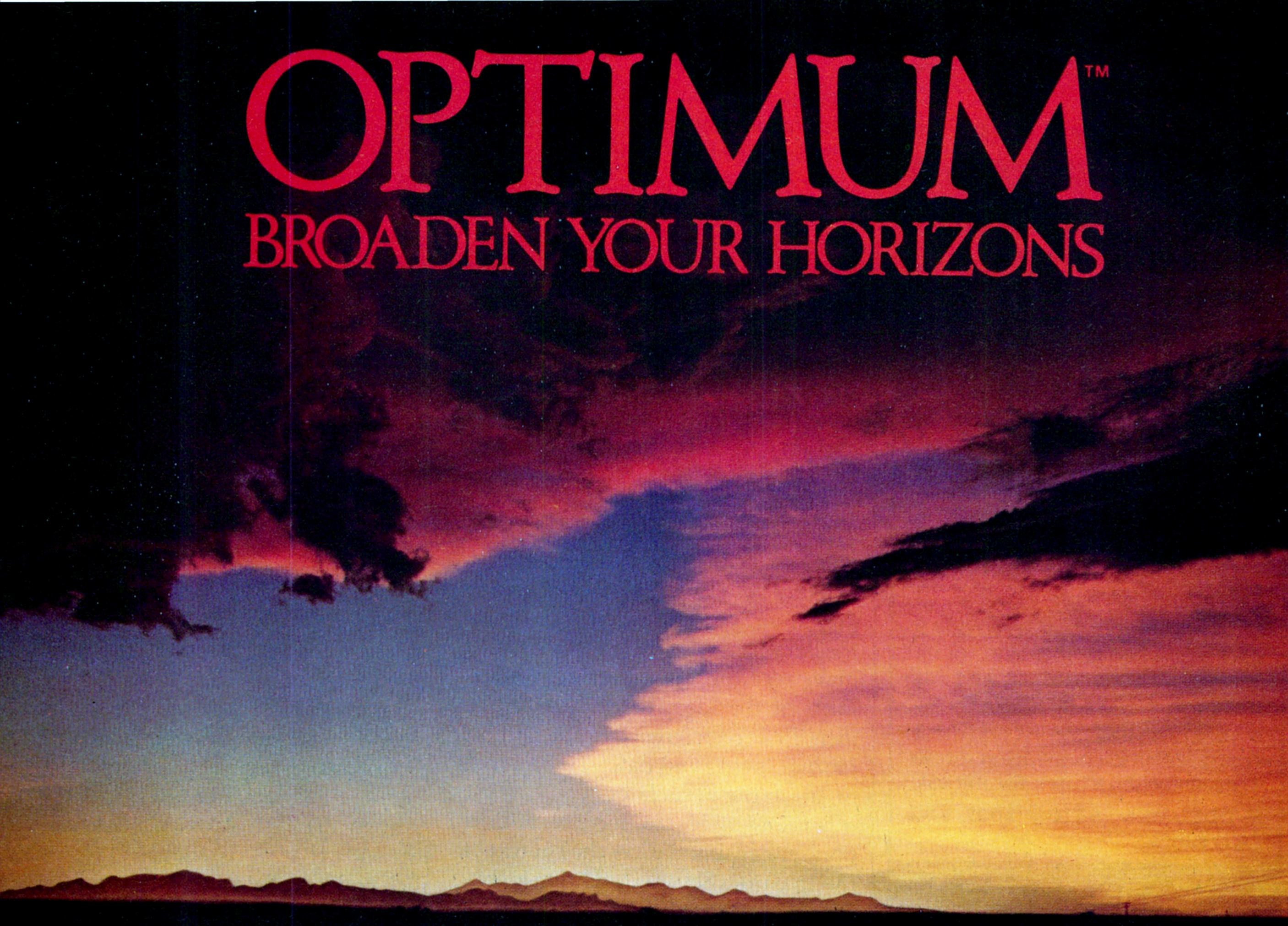

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paper is being outlined or written.

In many ways, note taking with a DBMS resembles note taking with note cards. For the note cards to be most useful, Lester (see references at end of article) suggests you put only one item of information on each card and include a brief citation or reference to the source of the idea. He also suggests you label the note card at the top for speedy recognition of the topic. When you record only one idea on each card, you can later sort the cards according to your outline for the paper.

All the functions performed by note cards can be carried out more efficiently by a DBMS. For each idea or quotation, you can create a record in the data-base file which includes as its main text the quotation or a statement of the idea. Key fields can be identified for reference to the author, journal, page, and date. To help you organize the ideas later, you can use other key fields to include a brief phrase that summarizes the context of the record. Several additional key fields could contain other types of information to sort the files in many different ways.

Because the DBMS can perform the tedious tasks of creating the indices and sorting the records, it requires far less effort on your part than note cards do. Once note taking becomes less burdensome, you can devote more effort to the task of developing new ideas.

Data-base management programs typically require you to define a structure before entering the data or notes. The programs then use that structure to prompt you for specific types of information as the notes are entered. When the information is complex, this prompting and structure can help you by assuring that you don't inadvertently leave out critical information (the author of a reference book, for example).

In addition to the structural constraints on data entry, data-base management programs typically include procedures which check the data for proper form during input. If you mistakenly enter alphabetic data in a numeric field, for example, the data may be rejected, and you will be asked to start again. In addition, more sophisticated programs allow you to specify other criteria which may be examined before the data are accepted—helping to assure the quality of the data entered and improving the quality of the notes.

Outlining

While data-base management programs save time and improve quality at the note-taking stage, these benefits pale in comparison to the benefits for outlining. Much writing, particularly for research papers or technical papers, involves keeping track of a mass of information on various topics. Managing all this information quickly and efficiently is an awesome job for even the most gifted writer.

For example, in writing a paper reviewing several different software programs or comparing various hardware options, you need to keep track of many details to provide a clear picture of what is available. Writing such papers requires a vast amount of relatively simple but time-consuming work such as compiling lists, sorting references and ideas, and reorganizing points to fit a consistent argument or theme (to say nothing of the many data-handling tasks involved in generating the notes in the first place). The computer can do all these things without overlooking important ideas or misplacing relevant citations, and it can work faster than the most efficient writer.

But the savings in time and effort aren't the only advantages to using a DBMS for writing. By allowing you to organize and reorganize your notes with minimal effort, the system frees you to consider many different approaches to your subject. This luxury can lead to valuable insights and significant improvements in the paper.

Revising

The sorting, retrieving, and updating capabilities that make the DBMS so useful for outlining also make the system valuable when your work needs major revisions. You can delete entire sections, add others, or reorganize your paper to fit a new

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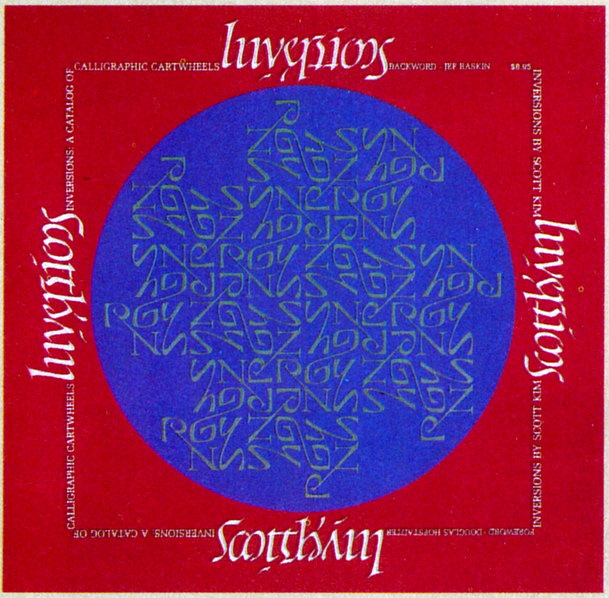
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Scott Kim is a doctoral student in Computer Science at Stanford University and is a concert pianist and composer.

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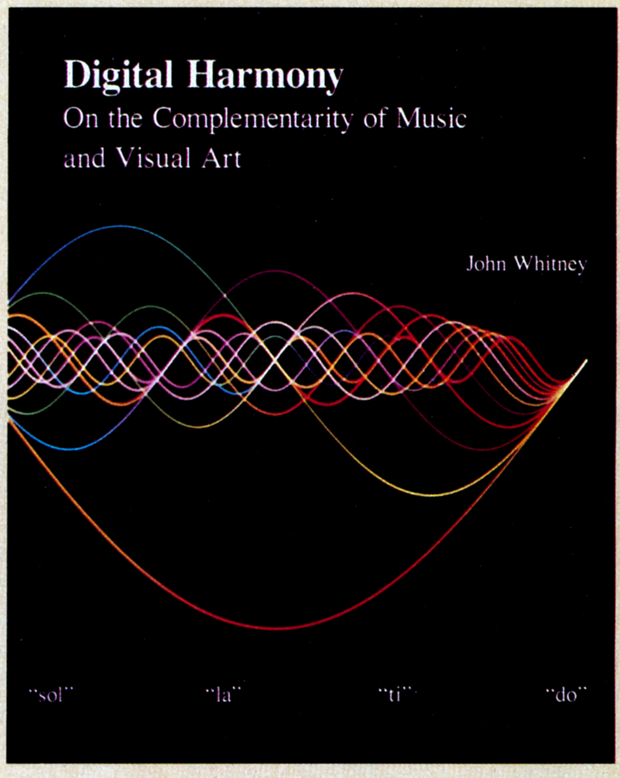

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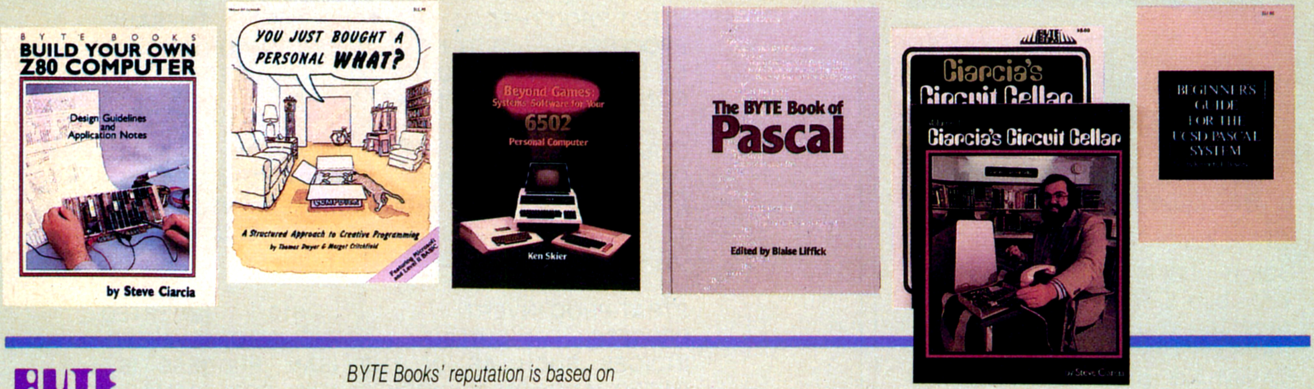
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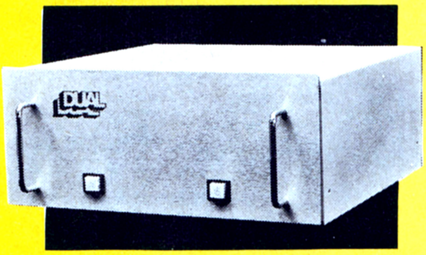

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Field Name	Length
HIERARCHY	25
ORDER	3
SUMMARY	8
KEY1	8
KEY2	8
TEXT	180

Figure 1a: *In a data-base management system used for writing, the data-base file consists of records, which in turn consist of fixed-length fields.*

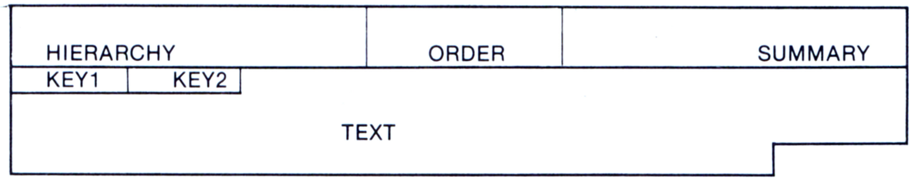

Figure 1b: *The report format used for printing out the records in the data base. The records in figure 1c follow this format.*

```
STRAT.STRUCT.CHANGE          S06     CHANGE
STRUCTURE     NOTES         IDEALLY, IT SHOULD B
E POSSIBLE TO CHANGE THE STRUCTURE AFTER
  THE IDEAS HAVE CHANGED SUFFICIENTLY THA
T IT IS NECESSARY TO MAKE IT RETAIN ITS
USEFULNESS.

STRAT.PROC.VOCAB             S07     VOCAB
PROCESS       OUTLINE       TO TAKE MAXIMUM ADVA
NTAGE OF SORTING, SEARCHING, AND RETRIEV
AL CAPABILITIES OF DBM PROGRAMS IT IS NE
CESSARY TO CONTROL WORDS USED TO AVOID S
YNONYMS.

STRAT.PROC.THESAU            S08     THESAUR
PROCESS       OUTLINE       WHERE SYNONYMS MUST
BE USED, A THESAURUS MAY BE USED TO HELP
CONNECT THE APPROPRIATE WORDS.

STRAT.PROC.HIER              S09     HIERARC
PROCESS       OUTLINE       HIERARCHICAL DATA ST
RUCTURES MAY BE INCORPORATED INTO THE KE
Y FIELDS THROUGH SUCCESSIVE SMALL FIELDS
OR A SINGLE LARGE ONE.

STRAT.PROC.INVERT            S10     INVERTED
PROCESS       OUTLINE       THE USE OF INVERTED
INDICES SUCH AS IN THE ISAM PROCESS IS L
IMITED AND ONLY WORKS WELL FOR SMALL FIE
LDS WHERE ALPHABETIC OR NUMERICAL ORDER
MAKES SENSE.

STRAT.PROC.SEQ               S11     ORDER
PROCESS       OUTLINE       STRATEGY: ONE OR MO
RE KEYS MAY BE SET ASIDE TO BE USED TO O
RDER THE RECORDS LATER BY INSERTING KEY
VALUES APPROPRIATE TO SOME ORDER.

STRAT.PROC.UPDATE            S12     UPDATE
PROCESS       OUTLINE       REGARDLESS OF HOW WE
LL THE STRUCTURE IS DEFINED, IT WILL PRO
BABLY BE NECESSARY AND DESIRABLE TO UPDA
TE THE FILE AND CHANGE THE APPROPRIATE K
EYS AS IDEAS BECOME CLEARER.
```

Figure 1c: *Sample records (part of the data base used in writing this article) are shown printed out in report format. A word-processing program would be needed to provide lowercase output and line endings on word boundaries.*

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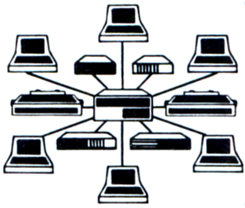

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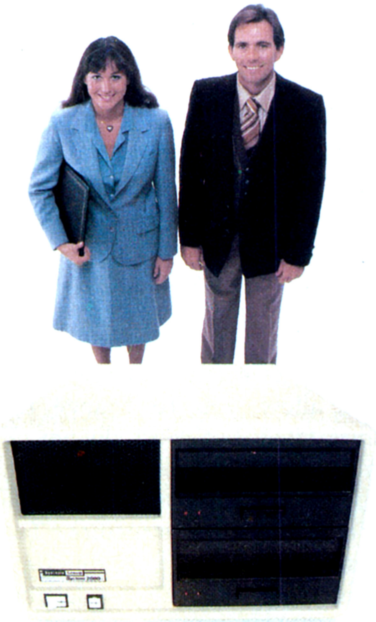

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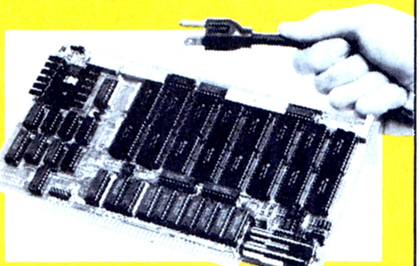

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theme or address new issues. Word-processing programs, however, may be a better choice for making minor revisions because they can conveniently modify and print out the text in the desired format.

Strategies for Using a DBMS

The standard advice on using a tool properly is especially *à propos* when the tool is a DBMS. Unless you start with a clear plan and a good knowledge of the tool's capabilities, a data-base-management system could actually impede your work. I'll present guidelines for the two major uses of a DBMS in writing: note taking and organization.

Note-Taking Strategies. At the note-taking stage, you must first set up a structure that takes maximum advantage of the DBMS's recording, structuring, prompting, data quality checking, and updating capabilities. At the same time, the resulting data base should be designed so that you can later use the system's organizing and retrieval functions. The watchword for note taking, then, is structure. Ideally, the structure should be appropriate to the task, inclusive, and flexible.

Appropriate level of structure. You can use data fields in several ways to provide structure consistent with your thinking. The first way involves *keyword fields*. Because ideas for a paper usually develop over time, you may not always know in advance the categories that will be relevant to the final paper. For this reason, you can make some provision in the data base for storing information in a flexible form such as open keys based on keywords, rather than rigidly prescribed categories fixed in advance. The second strategy uses *labeled fields*. If you can identify categories that will be relevant for the final paper, you can set aside specific fields for information relating to those categories. These keys usually have a restricted number of acceptable responses, which you may or may not know when you first define the field. You can develop new categories of acceptable responses for the field as the paper progresses. When you know in advance the categories and variables which define the fields, you can use abbreviated symbols called *table lookup keys* to represent the acceptable responses. You can then look up the symbols in a table if your computer cannot perform that function itself.

The sample data base in figure 1 (page 28) includes: two open key fields (KEY1 and KEY2) in which any key words may be entered; labeled fields (HIERARCHY, SUMMARY, and TEXT) in which only prescribed data may be entered; and one table lookup key (ORDER) in which only abbreviated symbols having specified meanings can be entered.

Inclusive structure. A data-base structure is of only limited use if it is not inclusive. A data base full of quotations, for example, does not help a writer unless it includes the information necessary for citing the appropriate references. During note taking, be sure to include all the information you'll need at the end; otherwise, you'll have to go back to the original sources to retrieve that information.

Flexible structure. Once you have created a data file, its structure (the number and size of data fields and the definition of permissible data for each field) is very difficult to change. You must, therefore, define the fields broadly enough to encompass likely changes in the categories without requiring major changes in the data structure. The sample data base in figure 1 contains several fields (HIERARCHY and ORDER in particular) that could not be filled out when the data were first entered, but they were very helpful later. No matter how well you plan the data structure, however, there may be times when your ideas change so much as the paper develops that the original structure no longer suffices. A few DBM systems allow you to change the structure later, but most do not. If yours falls into the latter category, you'll have to write a program if you want to change the structure. The program could convert existing data bases into new structures by deleting old key fields, adding new ones, changing the overall size of a record, or even converting values in existing fields.

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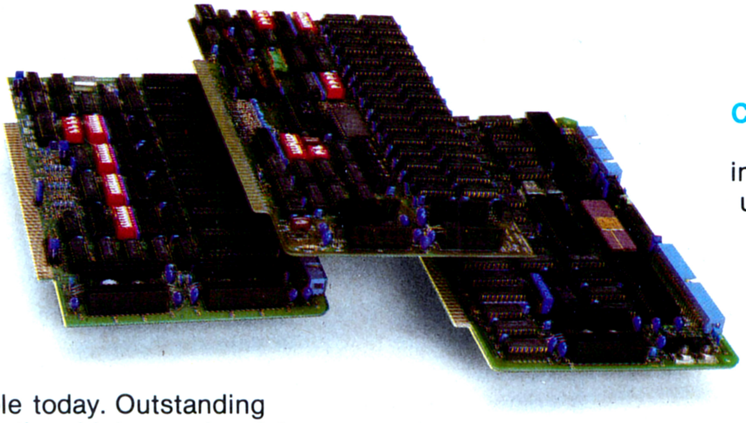

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Organization Strategies. While organizing whatever you're writing, take advantage of the DBMS's ability to sort, search, and print reports. At the same time, you'll need to cope with the limitations of the DBMS. Some strategies for dealing with those limitations are discussed in the following paragraphs.

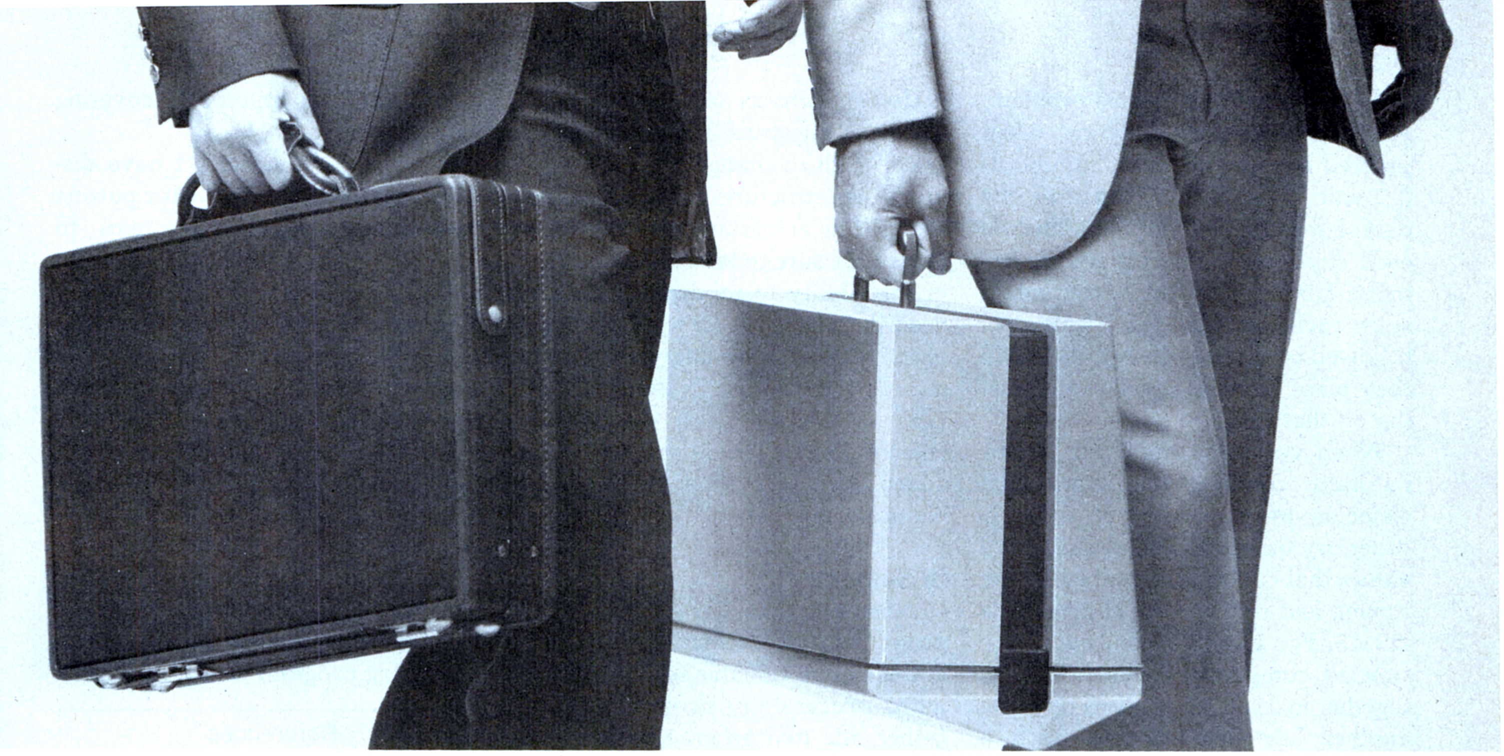
Thesaurus or vocabulary control. As you enter data into the various fields of the data base, you may encounter problems when you use more than one term for the same concept. For example, if you're writing about elderly people, a computer sort of the file may put all the "elderly" people in one place, the "aged" in another, and the "old" in still another. Computer-based data systems take expressions literally; they don't recognize synonyms. Because a file sort would not group together all the related records about elderly people, you would have to make a separate search for each possible term. One way to prevent synonyms from reducing the usefulness of the DBMS is to exercise control as the information is entered into the computer. You could also use a computerized thesaurus, which allows the computer to recognize different words that have similar meanings.

Hierarchical structures. Data fields may be used to create various types of data structures to meet your needs (see the Kerschberg reference at the end of this article). For example, many DBM programs are already set up to provide *relational* data models in which each record is classified by a common set of variables. *Hierarchical* data models store information in tree-like structures according to criteria which begin broadly and become successively more detailed. You can produce hierarchical data models with a typical DBMS in at least two ways. You can use one large key in which the hierarchical information is recorded in specified order (from most general class to most specific class) separated by delimiters such as slashes or periods. Another way is to use a series of smaller keys, each representing a specific level in the hierarchy. The first key might be the most general class; the second, the next most general, and so on. Either way, the key fields can be used in combination to order the records by some hierarchical scheme. This strategy is illustrated in figure 1 by the HIERARCHY field, which consists of a series of abbreviated terms separated by delimiters. The terms define the hierarchical relationship between the various records.

Use inverted indices sparingly. An inverted index is one in which records are ordered according to a sort done on one key field in each record. Using the indexed sequential-access method (ISAM), such indexes allow fast searching and record retrieval—much faster than you would get with an unordered data base. However, inverted indices have their limitations.

First, they order files alphabetically or numerically by the values in the *first portions* of keys. Hence, long keys such as titles are ordered only by the first few letters or words, which won't help you if the keywords of interest occur later in the title. In essence, inverted indices examine only the first segments of the text and do not consistently identify keywords imbedded within the text at other points. For fields containing several words, it may be best to use a search of the entire text in that field rather than an inverted index based on that field. One way to cope with this problem when using key words is to use several small key fields, each containing a single keyword, instead of using one long key field containing several keywords. This way, you can create separate inverted indices for each keyword without having to search the entire text. However, when the same term can appear in any of the key fields, the file must be searched several times, once for each of the possible fields in which the term may appear. This problem is illustrated in figure 1 by the TEXT field. There would be little point in creating an inverted index for that field because it would order the records by the first few words in the field.

A second limitation of inverted indices is that they order the file in alphabetical or numerical order, which may not be useful for the data



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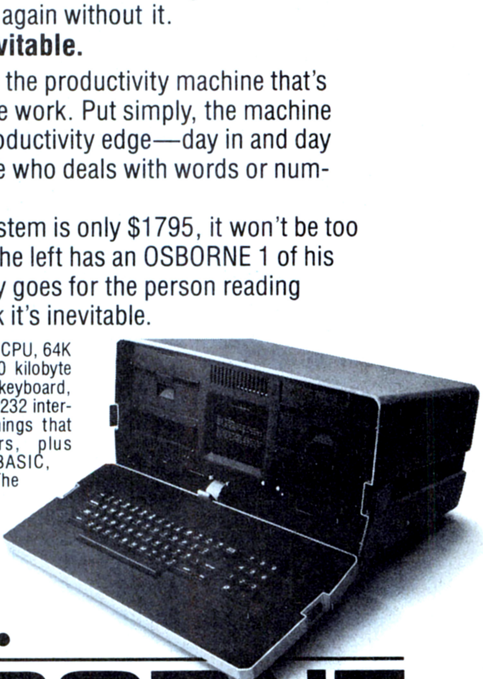

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at hand. To cope with this problem, you can make entries which, when ordered alphabetically or numerically, will meaningfully organize the data. For example, instead of labeling each strategy with a different summary label for sorting, you might start each with an identical label followed by a number. A DBMS will then place them together when sorting on that field.

When you can't use labels which naturally combine the appropriate elements in alphabetic or numeric order, try using special keys to record values that can take advantage of the sorting and retrieval capabilities of a DBMS. For example, you can make sure all comparable records end up together in a sorting analysis by using another key field to give each a distinctive letter and/or number.

This strategy is illustrated in figure 1 by the ORDER field. The "S" prefix causes the strategies to be sorted together and the following number determines the sequence in which the strategies will appear.

Update data as structures evolve. Although the structures of a data base are difficult to change, the data within those structures can be easily changed as errors are noted or ideas evolve. Be sure to take full advantage of this ability to modify the data as needed. In figure 1, for example, most of the records in the data base did not include information in the HIERARCHY or ORDER fields when I first entered them. The information was added later, as I developed a clearer picture of the paper.

In Summary

When you're undertaking a writing project, data-base management programs can be valuable supplements to word-processing programs. Together, the two programs allow you to use the computer to relieve much of the drudgery of note taking, indexing and typing draft after draft—thus freeing you to spend more time exploring new ideas. Data-base management programs are particularly useful for technical writing that involves complex arguments covering many issues.

The specific strategies I have discussed suggest some ways for putting data-base management systems to work for note taking, outlining and radically revising papers. You can experiment with strategies for handling still other tasks and making even more efficient use of the DBMS for writing. It would be particularly helpful to develop DBMS and word-processing programs that are compatible with each other. In that way, the data base created in the earlier stages by a DBMS could form the beginning of a text that would be modified and revised by the word-processing program. ■

References

1. Kerschberg, L, A Klug, and D Tsichritzis, "A Taxonomy of Data Models," in P C Lockemann and E J Neuhold (eds), *Systems for Large Data Bases*. New York: North-Holland, 1976.
2. Lester, J D, *Writing Research Papers: A Complete Guide*. Glenview, Ill.: Scott, Foresman, 1971.

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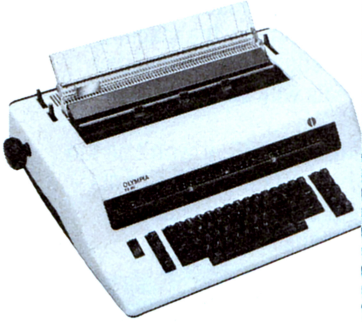

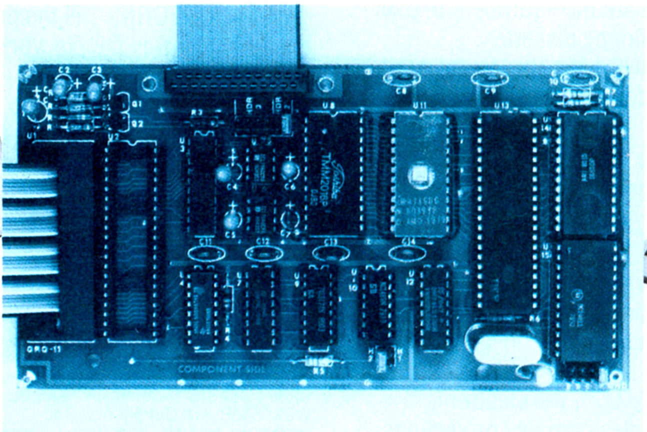

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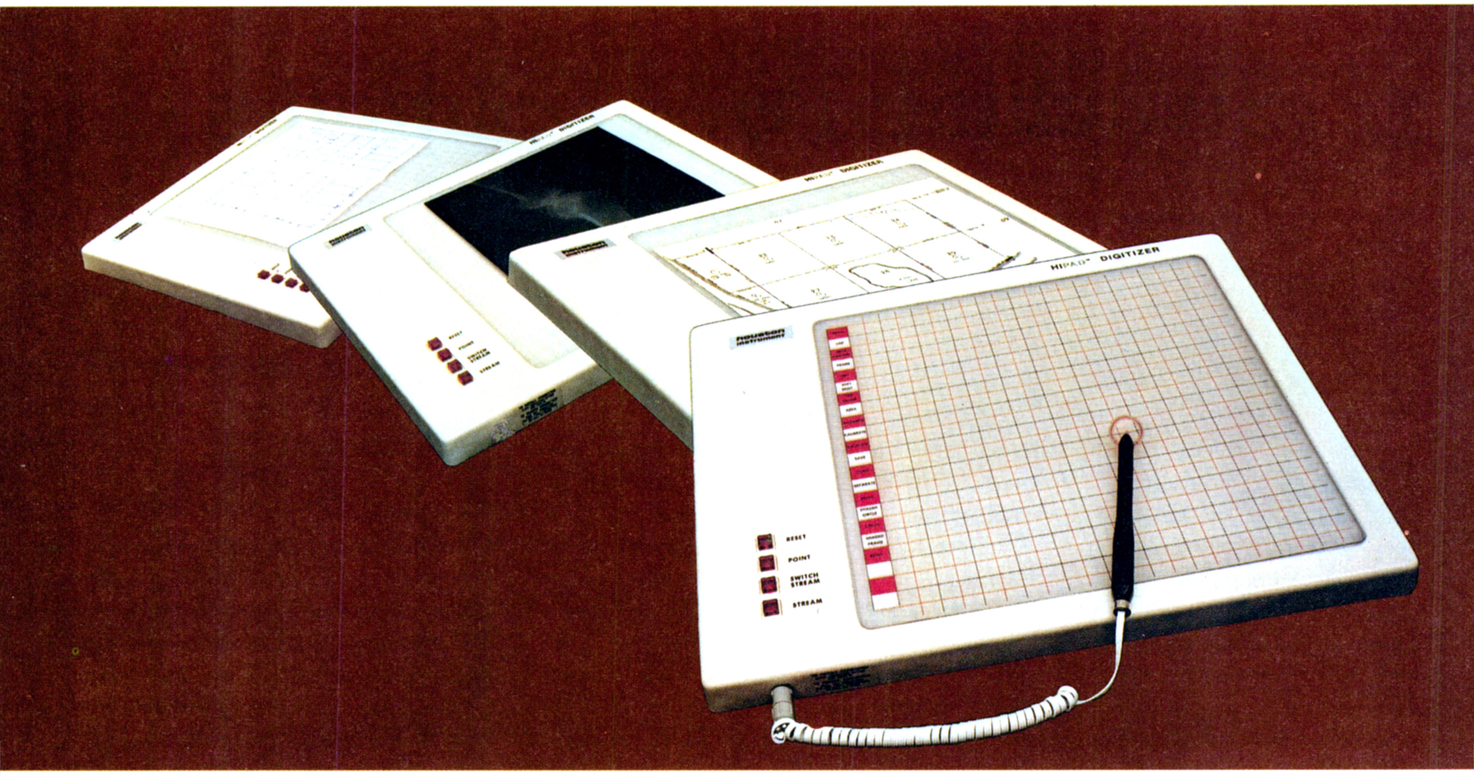

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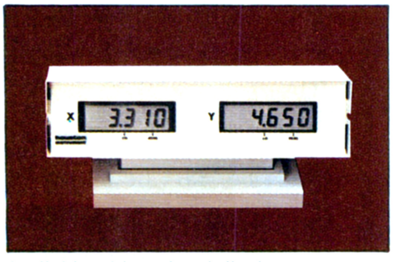

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Switching Power Supplies

An Introduction

Steve Ciarcia
POB 582
Glastonbury CT 06033

Since the advent of the three-terminal integrated-circuit voltage regulator, it seems that everyone has become a power-supply expert. No longer are ten pages of calculations required to produce a design for even a modest power supply, thanks to the wide tolerances and relatively sturdy architecture of these devices. After you have purchased a few readily available parts, you can have your completed supply running in a few hours.

Three-terminal regulators have become so easy to use that few experimenters stop to consider how inefficient they are. For example, if we were to design a 5-volt 1.5-amp power supply from commonly available parts, we would probably use a 12.6 VAC transformer, a bridge rectifier, a filter capacitor, a three-terminal regulator (such as an LM317), and a few discrete components. (A 6.3 VAC transformer is only marginally usable.)

Photo 1: *Ferrite toroids and pot cores are available in various sizes and compositions. These units are from the Ferroxcube Division of Amperex Electronics Corporation, 5083 Kings Hwy, Saugerties NY 12477, (914) 246-2811.*

Set up normally, the transformer, rectifier, and filter produce about 16 volts. With the LM317's output adjusted for 5 volts, 11 volts would be dropped across the regulator. ("Dropped" really means "consumed" in this case.) Power is dissipated by the regulator in an amount equivalent to the difference between the regulator's input and output voltages multiplied by the current through it. In this instance,

$$(16\text{V} - 5\text{V}) \times 1.5\text{ A} = 16.5\text{ W}$$

The conversion efficiency is

$$V_{OUT}/V_{IN} = 5/16 = 31\%$$

The LM317 and similar linear regulators (shown in figure 1) such as the 7805 and LM340 are all called *series dissipative regulators*. They function in a linear mode, simulating a variable resistance between the input-voltage source and the load. There are other factors involved, but basically the linear series regulator simulates a varying resistance. Within a specified range of variation in the input voltage and load current, the regulator maintains a constant output voltage by dissipating the excess power as heat. Unfortunately, as we see in this example, it consumes 16.5 watts producing the desired 7.5-watt output.

In most applications, however, the ease of use and relative low cost of linear series regulators far outweigh the inherent lack of efficiency. The linear series regulator is well suited for medium-current applications with a small voltage differential, where the power dissipation can be handled with heat sinks and cooling fans. When electricity costs only five cents per kilowatt-hour (1000 watts for one hour), it's hard to get concerned about losing 16.5 watts.

Why Use a Switching Regulator?

Power-supply efficiency usually isn't important unless size, heat dissipation, or total power consumption is limited. If the power source for our regulator were a battery, we would have to be more careful about how much energy is converted for useful work and how much is thrown away as heat.

Efficiency is really the name of the game. In a series dissipative regulator, conversion efficiency is directly related to the input/output voltage differential. As the difference between the two voltages increases, efficiency decreases. The power radiated by the regulator represents a loss to the system and limits the amount of power deliverable to the load.

It would be far better if the regulator consumed no power and if all the power were channeled to the load. While perfect conversion efficiency is impossible, the inherent fault in using series dissipative regulators is the linear operating mode of the series-pass transistor.

If, however, the transistor is used as a *switch* (in saturated operation) rather than as a variable resistor (in linear mode), the series-pass transistor consumes very little power. (This is not a new discovery. Designers have always been aware of the technique, but it required some time to develop cheap, fast switching transistors and inexpensive, low-loss ferrite materials from which cost-effective switching supplies could be built.)

A regulator constructed to operate in this manner is called a *series switching regulator*. The same series-pass transistor switches between cutoff and saturation at a high frequency, producing a pulse-width-modulated square wave of amplitude V_{IN}. This waveform is then filtered through a low-pass LC (inductance/capacitance) filter, producing an average DC output potential (V_{OUT}) proportional to the pulse width and frequency. The efficiency of such a regulator is generally independent of the voltage differential and can approach 95% in good designs.

Switching regulators come in various circuit configurations, a few of which are the flyback, feed-forward, and push-pull types. I am limiting this discussion primarily to another type, nonisolated single-ended (single-polarity) switching regulators, because they are the easiest to understand and build. Although simple, they are nonetheless quite useful. Unlike the typical three-terminal dissipative regulator, the switching regulator can be directly configured to operate in any of three modes: step-down, step-up, or polarity-inverting.

Switching-Regulator Basics

Figures 2a through 2c on page 39 outline the three common modes of switching-regulator operation. Basically, the switching regulator consists of a power source which supplies a voltage V_{IN}, a "switch" Q1, and an LC filter. (It is assumed in all cases that a load is connected between the output and ground and that Q1 is actually a transistor controlled through external circuitry.) The way the components are connected determines the output mode.

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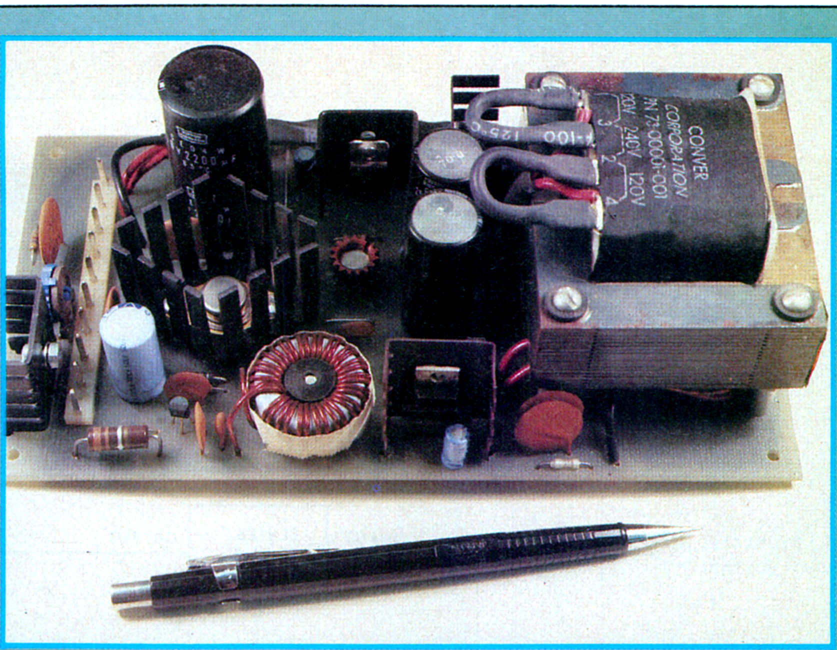


Photo 2: *A commercially sold switching power supply that combines both linear-regulator and switching-regulator technology to provide outputs of ±12 volts and +5 volts. Note the use of the toroidal inductor and the relatively small heat sinks. This unit was made by Conver Corporation, 10631 Bandley Dr, Cupertino CA 95014, (408) 255-0151.*

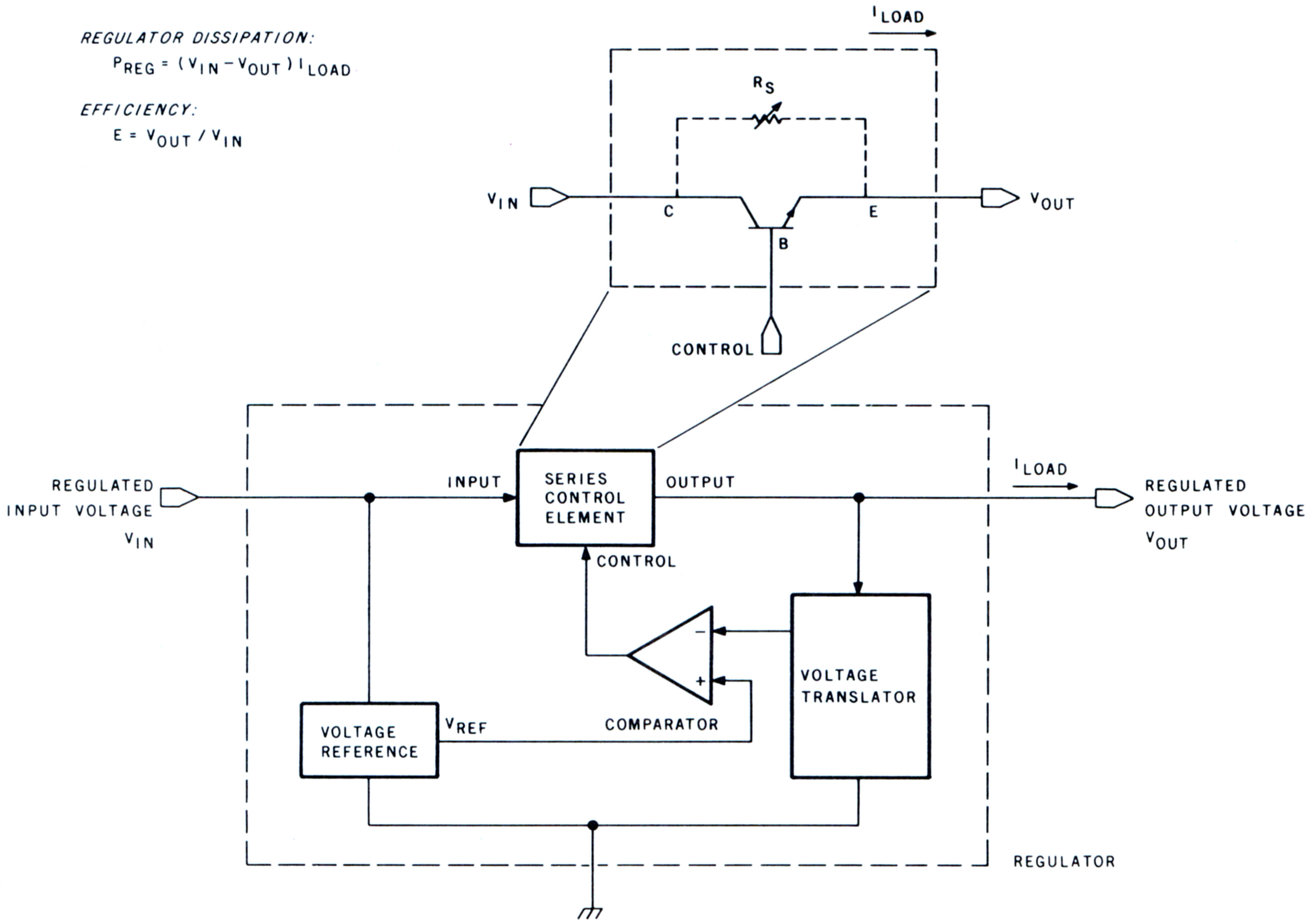
In the *step-down* regulator of figure 2a, the basic circuit operation is to close switch (transistor) Q1 for a time T_{ON}, and then open it for time T_{OFF}. The total, $T_{ON} + T_{OFF}$, is called the switching period T. Neglecting the saturation voltage of Q1 (V_{SAT}) and the diode (V_{DIODE}), the voltage at the input to the inductor is $+V_{IN}$ during the time T_{ON} and zero during T_{OFF}. (But remember, these other voltage drops must be included in our calculations when we are choosing actual components.)

When Q1 is closed, a step increase in voltage is applied to the inductor coil, which has the value L. However, current flowing through an inductor cannot change instantaneously; instead it increases linearly according to the factor $L(di/dt)$, building a magnetic field. This reduces any instantaneous current change seen by the load. When Q1 opens, the magnetic field in the inductor decays linearly, supplying power to the load. The current path is completed through the forward-biased flyback diode D1.

In this type of switching regulator, the inductor and capacitor form a low-pass filter. High-frequency pulses are applied to the input, and an averaged DC level comes out. The peak-to-peak ripple voltage is a function of the switching period T and the values of the inductance L and capacitance C. As the frequency of operation is increased, the voltage ripple is reduced, but the supply becomes less efficient.

Figure 2b illustrates the circuit configuration of the basic *step-up* switching-type voltage regulator. In this type of regulator, closing Q1 during T_{ON} charges the inductor. When Q1 is opened, the inductor discharges through D1 into the load. The output voltage is determined by the rate of discharge according to the equation

$$V = L(di/dt)$$



REGULATOR DISSIPATION:
$P_{REG} = (V_{IN} - V_{OUT}) I_{LOAD}$
EFFICIENCY:
$E = V_{OUT} / V_{IN}$
I_{LOAD}
R_S
V_{IN}
C
E
B
V_{OUT}
CONTROL
REGULATED INPUT VOLTAGE V_{IN}
INPUT
SERIES CONTROL ELEMENT
OUTPUT
I_{LOAD}
REGULATED OUTPUT VOLTAGE V_{OUT}
CONTROL
VOLTAGE TRANSLATOR
COMPARATOR
VOLTAGE REFERENCE
V_{REF}
REGULATOR

Figure 1: *Block diagram of a typical linear series voltage regulator, such as the LM317, LM340 or 7805. The series regulator acts as a varying resistance, dissipating excess power as heat to maintain a constant output voltage.*

A fast discharge delivers an output voltage higher than input V_{IN}.

Figure 2c shows a *polarity-inverting* switching regulator. As in the other cases, closing Q1 charges the inductor during T_{ON}. When Q1 is opened during T_{OFF}, there is a "kickback" voltage produced by the inductor as it discharges. This effect occurs elsewhere, too. For years, many of you have probably been putting reverse-biased diodes across relay coils, perhaps without thinking about it. The purpose of the diode is to dampen the high-voltage spike produced when a pulse is applied to the inductive relay coil. In the power-supply situation, rather than short out the voltage, diode D1 directs this opposite-polarity voltage to the load.

Generally speaking, in all three cases, the output voltage V_{OUT} is regulated by controlling the ratio of T_{ON}/T. This *duty cycle* can be altered in a number of ways depending upon the control method. Two of the more common approaches are variable pulse width (pulse-width modulation) and variable frequency. In a pulse-width-modulated switching regulator, the switching period T is fixed and the "on" time T_{ON} varied. Conversely, in a variable-frequency regulator, T_{ON} is fixed and the "off" time T_{OFF} varied.

You can experiment with a simple design for a nonisolated single-ended switching voltage regulator.

The variable-frequency switching regulator is generally easier to design and build, since the magnetic flux developed in the inductor coil during the fixed on-time determines the amount of power deliverable to the load. This eases the design of the inductor because the inductor's operating region within its characteristic curve is precisely defined. Operating frequency, which increases proportionally with the load, is primarily a function of the inductance L, capacitance C, and voltages V_{IN} and V_{OUT}.

The fixed-frequency pulse-width-modulated switching regulator varies the duty cycle to change the average power delivered to the load. This method is particularly advantageous for systems employing transformer-coupled output stages and is most

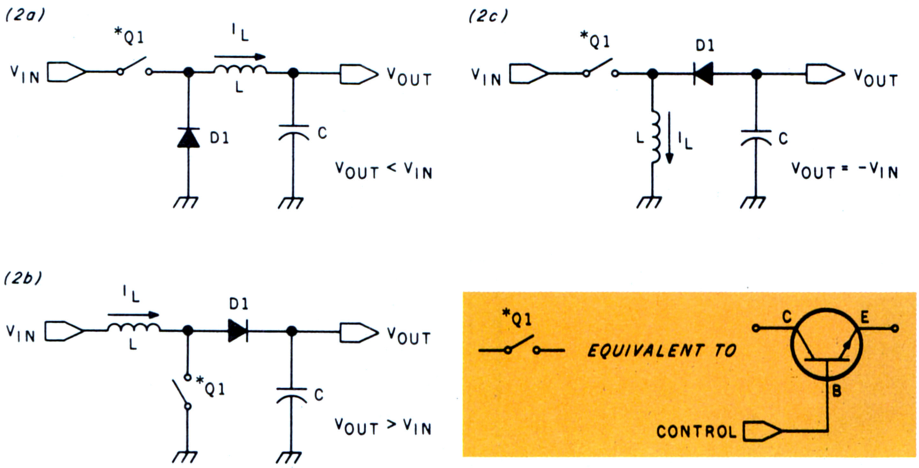

(2a)
*Q1
I_L
V_{IN}
L
V_{OUT}
D1
C
$V_{OUT} < V_{IN}$
(2c)
*Q1
D1
V_{IN}
V_{OUT}
L
I_L
C
$V_{OUT} = -V_{IN}$
(2b)
I_L
D1
V_{IN}
L
V_{OUT}
*Q1
C
$V_{OUT} > V_{IN}$
*Q1
EQUIVALENT TO
C
E
B
CONTROL

Figure 2: *The configurations of switching voltage regulators: the voltage-step-down (2a), voltage-step-up (2b), and polarity-inverting (2c) arrangements are depicted. The component shown as a switch is assumed to be a bipolar transistor driven in saturated switching mode. Some commercial designs may use field-effect transistors.*

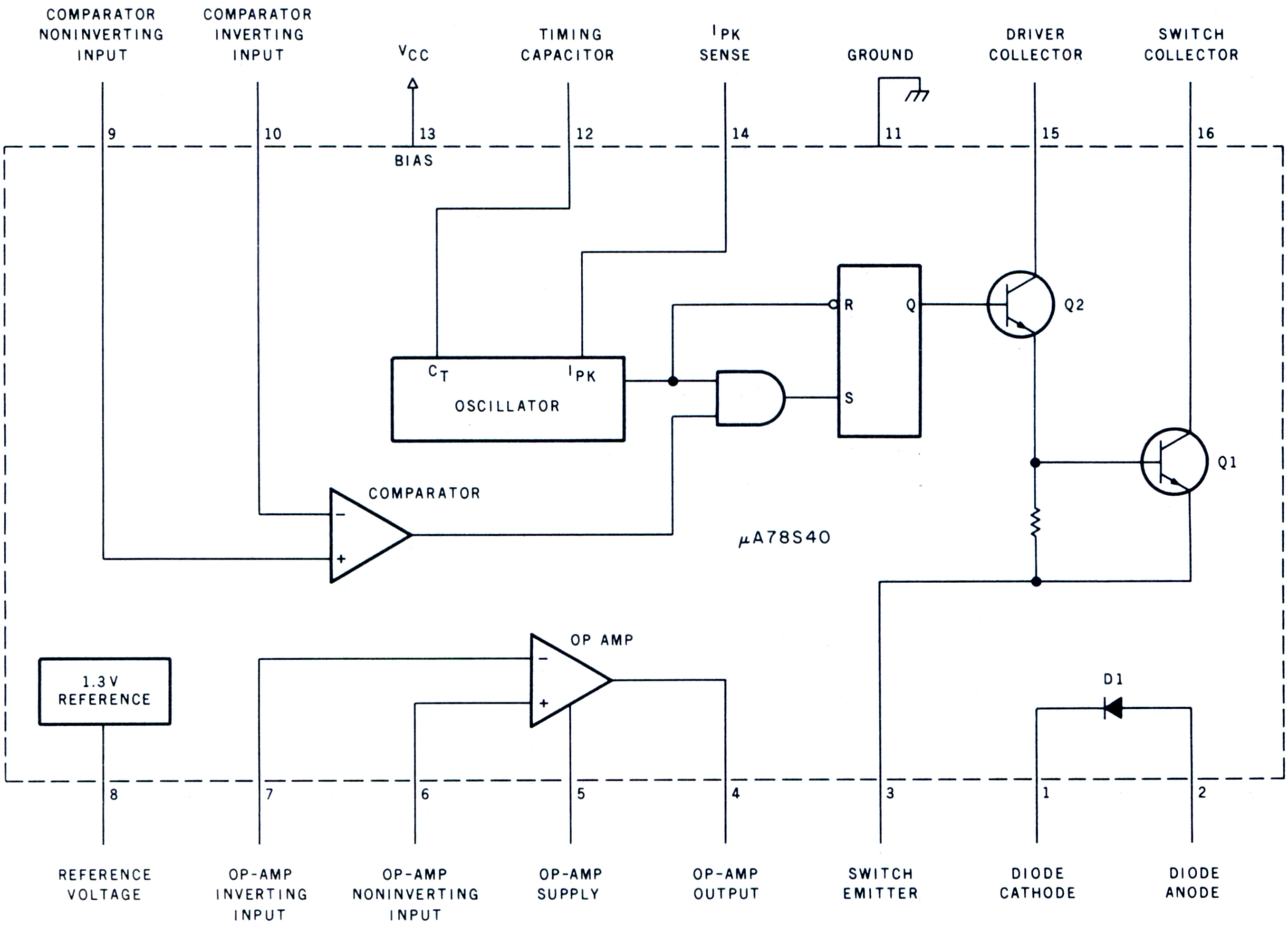

COMPARATOR NONINVERTING INPUT
COMPARATOR INVERTING INPUT
V_{CC}
TIMING CAPACITOR
I_{PK} SENSE
GROUND
DRIVER COLLECTOR
SWITCH COLLECTOR
9
10
13
BIAS
12
14
11
15
16
R
Q
Q2
S
C_T
I_{PK}
OSCILLATOR
Q1
COMPARATOR
μA78S40
OP AMP
1.3 V REFERENCE
D1
8
7
6
5
4
3
1
2
REFERENCE VOLTAGE
OP-AMP INVERTING INPUT
OP-AMP NONINVERTING INPUT
OP-AMP SUPPLY
OP-AMP OUTPUT
SWITCH EMITTER
DIODE CATHODE
DIODE ANODE

Figure 3: *Functional block diagram of the Fairchild 78S40 switching-regulator integrated circuit. This component may be obtained from the supplier listed on page 45.*

often used in commercial switching supplies with multiple outputs. This method is more complex and uses more components than variable-frequency supplies, but the advantages outweigh the extra cost in high-current applications.

Typical operating frequencies of switching regulators range from 10 to 50 kHz. However, there are some trade-offs. High frequencies reduce the ripple voltage at a price of decreased efficiency and increased radiated electrical noise. If the frequency is lowered, greater efficiency and less electrical noise will result, but larger coils and capacitors are needed. Also, a switching power supply operating at 10 kHz can become quite annoying to listen to after a while.

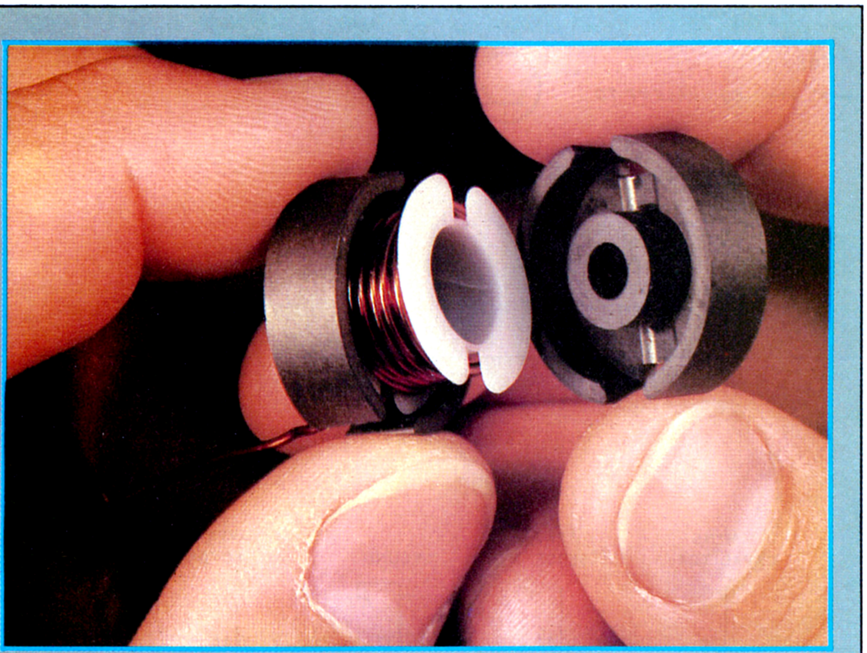


Photo 3: *Winding the inductor for the switching supply of figure 6a. The turns of wire are neatly wound around a plastic bobbin, evenly distributed.*

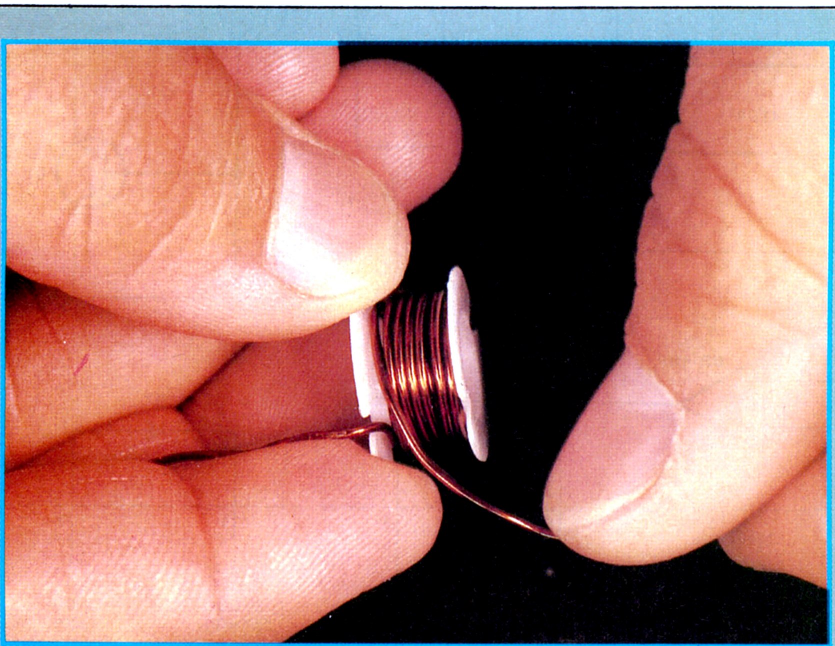


Photo 4: *Having been wound, the wire bobbin is placed between the two halves of the pot core, which are screwed together to form the finished coil.*

The most effective frequency range for optimizing efficiency and size with the components presently available is around 20 kHz. This is out of the range of human hearing yet low enough to be within the switching speeds of most inexpensive transistors and diodes. As switching speeds of newly developed high-current semiconductors increase and new ferrite components are introduced, practical operating frequencies will rise.

There are many kinds of switching regulator circuits that I could present. My previous article, "No Power for Your Interfaces? Build a 5 W DC to DC Converter" (reference 3), discussed the construction of a 5-watt converter which produced ±12 volts from a +5-volt input. This circuit was intended to facilitate powering linear interfaces and op amps (operational amplifiers) when the only source available was the 5-volt logic supply. If you have such a requirement, I refer you to that article.

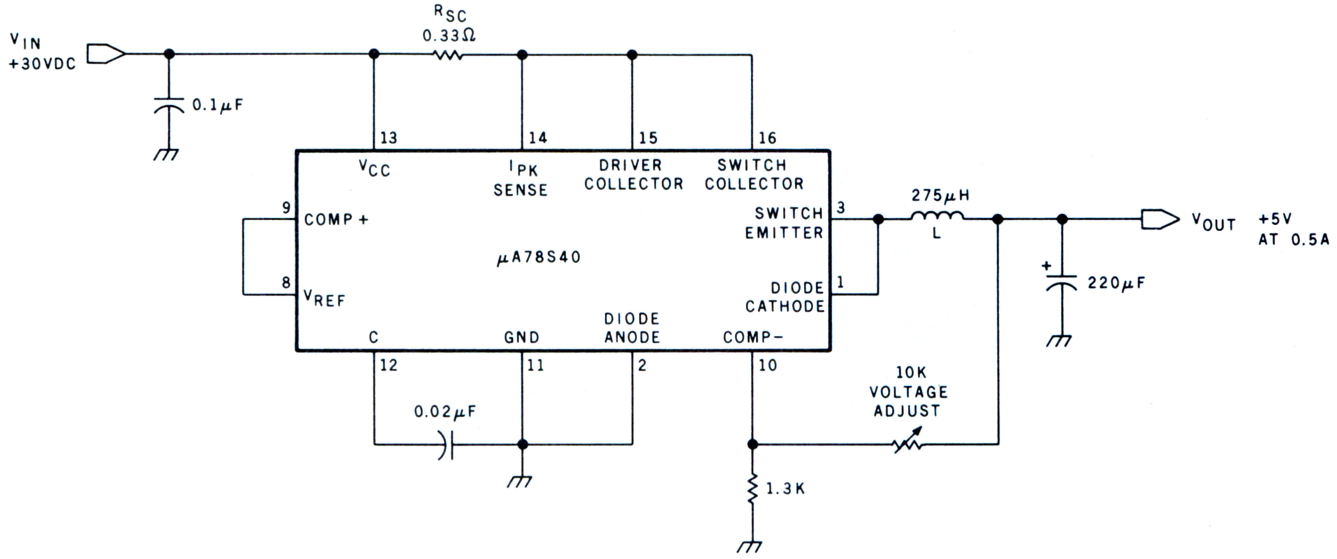
This time, however, I'd like to present circuits to meet a different need. In the example of the conventional power supply with which I began this article, the input/output voltage differential was so great that more heat than useful energy was produced by the supply. In a small electronic package which requires several watts, dissipated heat can be difficult to remove if the enclosure has no vents. This points out a need for a more efficient 5-volt regulator. While we're at it, we might as well make one that can accommodate up to 30-volt inputs without significantly increased losses.

One power supply that seems to be in demand lately is one with a +25-volt output for programming EPROMs (erasable programmable read-only memories, as discussed in last month's Circuit Cellar; see reference 2). While a three-terminal regulator can be used for this voltage, I see this as a ripe opportunity to demonstrate the step-up variety of switching regulator. One circuit we'll look at will therefore be a +5-volt to +25-volt converter suitable for EPROM-programming use.

78S40 Switching Regulator

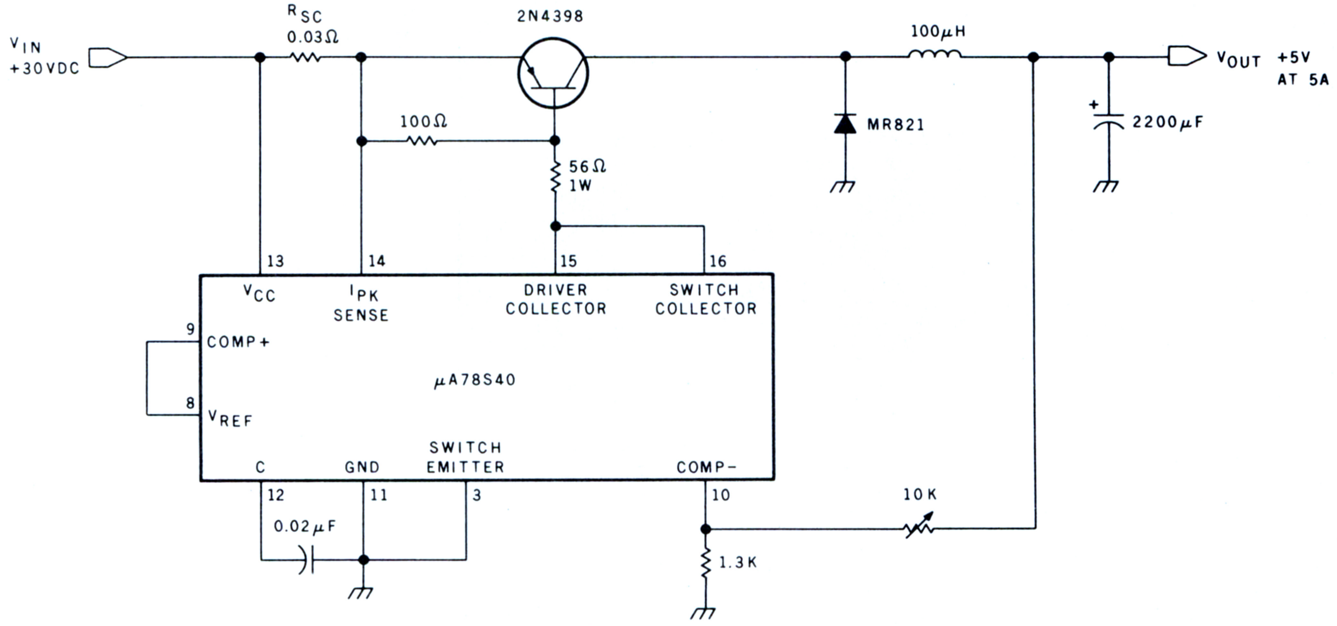
In recent years, monolithic (everything built on one semiconductor chip) linear voltage regulators have simplified power-supply design. Most systems have employed linear regulators because of their excellent reliability, low external parts count, and low cost. However, recent improvements in high-speed switching transistors and low-loss inductors have made switching supplies more attractive. The real breakthrough came with low-cost LSI (large-scale integration) monolithic switching regulators, which contain practically everything but the inductor on a single chip.

One of the many such integrated regulators available is the Fairchild 78S40, which is shown in the block diagram of figure 3. The 78S40 contains a current-controlled oscillator, current-limit sensor, voltage reference, high-gain comparator, high-current op amp, transistor switch, and power-switching diode. A single capacitor sets the frequency range (adjustable between 100 Hz and 100 kHz, but normally used at 20 to 30 kHz), and one external resistor provides current-limiting protection for the transistor and diode. Other than a few discrete resistors to set the output



V_IN
+30VDC
R_SC
0.33Ω
0.1µF
13
14
15
16
V_CC
I_PK
SENSE
DRIVER
COLLECTOR
SWITCH
COLLECTOR
9
COMP+
8
V_REF
µA78S40
SWITCH
EMITTER
3
DIODE
CATHODE
1
C
GND
DIODE
ANODE
COMP−
12
11
2
10
275µH
L
220µF
V_OUT
+5V
AT 0.5A
10K
VOLTAGE
ADJUST
0.02µF
1.3K

Figure 4: *Schematic diagram of a 5-volt, ½-amp step-down switching voltage regulator. For low currents, the 78S40's internal switching transistor and diode may be used.*



V_IN
+30VDC
R_SC
0.03Ω
2N4398
100µH
V_OUT
+5V
AT 5A
100Ω
56Ω
1W
MR821
2200µF
13
14
15
16
V_CC
I_PK
SENSE
DRIVER
COLLECTOR
SWITCH
COLLECTOR
9
COMP+
8
V_REF
µA78S40
SWITCH
EMITTER
C
GND
COMP−
12
11
3
10
0.02µF
10K
1.3K

Figure 5: *Schematic diagram of a 5-volt, 5-amp step-down switching regulator. An external heat-sinked transistor and diode are needed for the higher current.*

voltage, only an inductor and capacitor are required to make a highly efficient switching power supply. The internal Darlington-configured transistor switch and diode are capable of handling up to 1.5 amps (peak) at 40 volts.

While virtually no calculation is required to design a circuit that uses a three-terminal linear regulator, you have to do some math to arrive at the correct values for the external components to use with switching regulators. A simple circuit to demonstrate the math is a standard step-down regulator, as shown in the schematic diagram of figure 4. This circuit is a 30-volt input, ½-amp, +5-volt regulator, with a computed efficiency of about 82%. The computation appears in the text box "Component-Value Calculation" on pages 44 and 45.

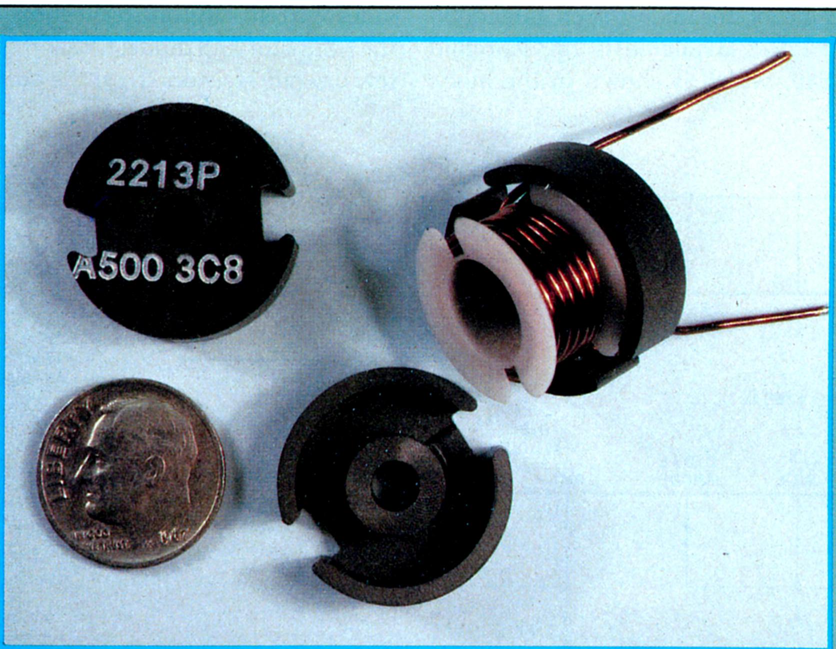


Photo 5: *Close-up of the pot-core halves and the bobbin.*

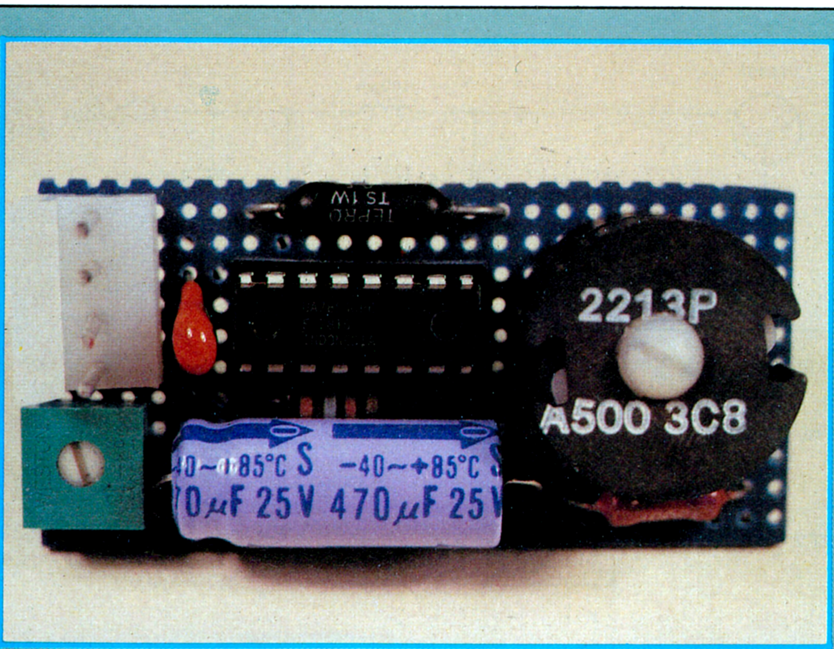


Photo 6: *A prototype of the step-up switching regulator of figure 6a. This circuit can be adjusted to produce voltages between +8 and +28 volts.*

In applications where the peak current is greater than 1 amp or where you need voltages greater than 40 volts, an external diode and transistor should be used with the 78S40. If you want to experiment, figure 5 shows a regulator designed to provide +5 volts at 5 amps. The component values were selected using the same equations described in the text box. After I had actually built the unit, however, I was unable to get a current greater than 3 amps out of it. I attributed this to using thinner wire in my inductor winding than I should have.

Another switching-power-supply circuit that might prove useful to you is shown in figure 6. Configured as a basic voltage-step-up regulator, this simple circuit converts +5 volts to +25 volts. With the voltage-adjustment pot shown, the circuit's output actually can be adjusted within a range of +8 to +28 volts. Set to +25 volts, it can be used as an EPROM-programmer supply. The design current rating is 200 milliamps, but this is dependent upon the output voltage. At 8 volts I measured 175 milliamps, but at 25 volts the maximum current was only 30 milliamps. Overall efficiency was about 70%. To achieve higher output currents at 25 volts, it is necessary to use an external switching transistor.

Winding the Inductor

The inductor coil in a switching regulator is designed for high power and large currents. Typically, the windings are around a ferrous core that is toroidal in shape, somewhat like a doughnut. The selection of a specific core size and core material for a desired inductance at a given steady current level is done through a set of iterative calculations using analytic curves showing permeability reduction versus DC magnetizing force (measured in oersteds).

The problem in selecting a core of suitable size and permeability is that all these parameters are interrelated. Rather than attempt to make everyone understand the curves and calculations, I prefer to take a little poetic license, by choosing a core which is optimal for the types of switching supplies I have just described. The remaining calculations are minor and less likely to discourage you from winding your own inductor.

The core I have chosen is the Ferroxcube 2213PA500-3C8, a pot-core set which differs from a pure toroid in that it consists of two cups which are secured together around a bobbin, around which, in turn, the windings are wound. Since the wire is wound on a bobbin rather than around the ferrite material itself, it is easy to change bobbins and experiment with various inductances produced by different numbers of turns and kinds of wire. Figure 7 outlines the characteristics of type-2213 pot core.

Two other factors are noteworthy in this selection. The type-2213 core is made in a variety of ferrite materials. I have chosen to use a type of material known as 3C8, which is a manganese-zinc ferrite substance with medium permeability and low losses. It is designed specifically for high-flux-density applications such as power supplies.

The 2213PA500-3C8 is a fixed-gap pot core. Flux saturation is avoided by introducing an air gap in series with the magnetic path. The effect of this 0.025-inch gap is to flatten the hysteresis loop, allowing greater cur-

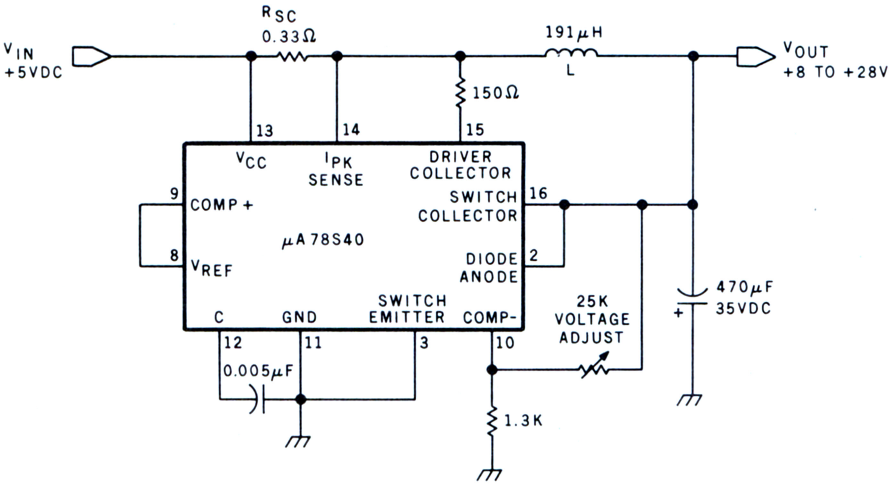


Figure 6a: *A step-up regulator that converts +5 volts to +25 volts, possibly for use in an EPROM programmer. The output voltage may be adjusted within the range of +8 to +28 volts. Current capacity depends on fine points of construction and on the voltage desired.*

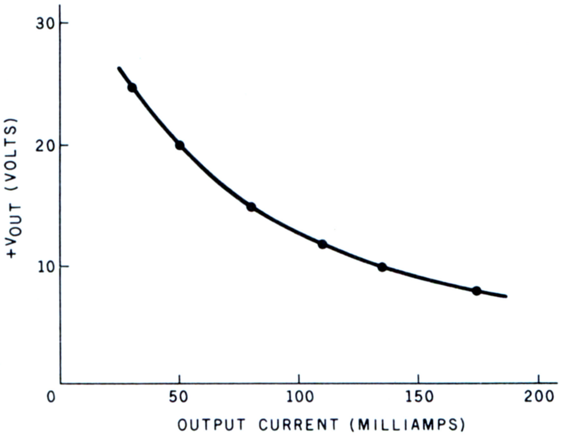
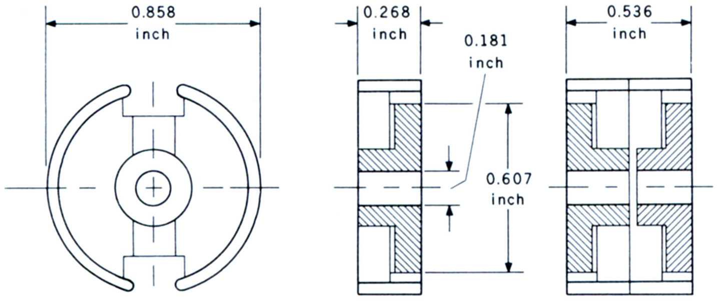


Figure 6b: *The measured curve of output voltage plotted against current for the step-up switching regulator of figure 6a.*



MAGNETIC PATH LENGTH	ℓ_e	1.23 inches 3.15 cm
CORE CONSTANT	$\Sigma \frac{\ell_e}{A_e}$	12.6/inch 4.97/cm
EFFECTIVE CORE AREA	A_e	0.0985 inch^2 0.635 cm^2
EFFECTIVE CORE VOLUME	V_e	0.122 inch^3 2.00 cm^3
MILLIHENRIES PER 1000 TURNS	A_L	500

Figure 7: *Physical and electromagnetic characteristics of the Ferroxcube 2213PA500-3C8 pot core. The coil turns are wound around a plastic bobbin that fits between the two core halves, easing experimentation with different numbers of turns and different gauges of wire.*

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rent densities without saturation. An added plus is that it reduces the overall inductance per turn of wire and allows more turns of wire for a given inductance value. Pot cores work best when the windings completely fill the core.

The calculations for winding the specific inductors for the power supplies I have presented are relatively simple. For each core and material, the manufacturer specifies a proportionality factor A_L, which is the inductance in millihenries per 1000 turns. The inductance for any other number of turns N is then

$$L = A_L N^2 \times 10^{-9}$$

or

$$N = \sqrt{\frac{L \times 10^9}{A_L}}$$

where

N = number of turns
L = desired inductance in henries
A_L = millihenries/1000 turns

The 5-volt ½-amp regulator presented earlier required a 275-microhenry inductor. For the 2213PA500-3C8 core, $A_L = 500$ millihenries per 1000 turns. Plugging these values into the equation:

$$\begin{aligned} N &= \sqrt{\frac{0.000275 \times 1000000000}{500}} \\ &= \sqrt{550} \\ &= 23 \text{ turns} \end{aligned}$$

In addition to determining the required number of turns, we must con-

Component-Value Calculation

Conditions:

V_D (diode-saturation voltage) = 1.25 volts
V_{SAT} (transistor-saturation voltage) = 1.1 volts
$V_{IN} = +30$ volts
$V_{OUT} = +5$ volts
I_{OUT} (maximum) = 0.5 amps
$V_{RIPPLE} < 1\%$ = approximately 50 millivolts
V_{REF} = (internal reference voltage) = 1.3 volts

Calculate:

$$\begin{aligned} I_{PEAK} &= 2I_{OUT} \text{ (maximum)} \\ &= 2 \times 0.5 \\ &= 1.0 \text{ amps} \end{aligned}$$

The peak-current rating of the transistor is 1.5 amps.

Next, determine the value of the current-limiting resistor:

$$\begin{aligned} R_{SC} &= 0.33/I_{PEAK} \\ &= 0.33/1 \\ &= 0.33 \text{ ohms} \end{aligned}$$

Calculate the T_{ON}/T_{OFF} ratio:

$$\begin{aligned} T_{ON}/T_{OFF} &= \frac{V_{OUT} + V_D}{V_{IN} - V_{SAT} - V_{OUT}} \\ &= (5 + 1.25)/(30 - 1.1 - 5) \\ &= 6.25/23.9 = \text{approximately } 0.26 \end{aligned}$$

Therefore:

$$T_{ON} = 0.26\ T_{OFF}$$

It is desirable to have the operating frequency of a switching regulator above 20 kHz (yielding a 50-microsecond period T), but neither T_{ON} nor T_{OFF} should be less than 10 microseconds for the 78S40 device. If we arbitrarily choose T_{OFF} to be 40 microseconds, then the values of the oscillator-timing capacitor (C_T) and inductor (L) are computed as follows:

sider the wire size and available space within the core. The objective is to fill the core, yet maintain a wire size that will carry the highest currents involved. There exist tables and charts of wire size, circular mils per ampere, and available-area specifications for exact determinations. As a rule of thumb, with designs like the ones presented here, the best tactic is to use the largest wire size that will fit for the required number of turns. If the pot core is not completely filled, the effect is not disastrous, but the true inductance could be as much as 10% less than calculated.

In Conclusion

I consider this subject a bit of a shot in the dark. I have found that as I build miniaturized electronic devices for my own use I can no longer tolerate the large volume, weight, and inefficiencies of linear-regulated power supplies. This article is a progress report on some of the circuits I have been experimenting with lately.

I don't anticipate any sudden shortage of ferrite cores as a result of the publication of this article. In my opinion, switching power supplies will come to have a very significant role, but mostly in commercially produced products. The greatest benefit of using this technology is the savings in energy and materials in large-scale production.

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$$
\begin{aligned}
C_T &= 0.00045\ T_{OFF}\\
&= 0.00045 \times 0.000040\\
&= 0.018\ \mu\text{F}
\end{aligned}
$$

Using a 0.02-microfarad standard capacitor value, T_{ON} and T_{OFF} really turn out to be:

$$
\begin{aligned}
T_{ON} &= 11.6\ \mu\text{s}\\
T_{OFF} &= 44\ \mu\text{s}\\
T &= T_{ON} + T_{OFF} = 55.6\ \mu\text{s}\\
C_T &= 0.02\ \mu\text{F}
\end{aligned}
$$

For the inductor:

$$
\begin{aligned}
L &= \frac{(V_{OUT} + V_D)\,(T_{OFF})}{I_{PEAK}}\\
&= (5 + 1.25) \times 0.000044/1\\
&= 275\ \mu\text{H}
\end{aligned}
$$

The output-capacitor value C is calculated from the ripple requirements:

$$
\begin{aligned}
C &= \frac{(I_{PEAK})\,(T)}{8\,(V_{RIPPLE})}\\
&= 1 \times 0.0000556/8 \times 0.05\\
&= 139\ \mu\text{F (use standard 220 }\mu\text{F)}
\end{aligned}
$$

Finally, compute the values of the two resistors required for the sampling network. Assuming that the comparator-input current is 1 milliamp (the comparator will work down to 100 microamps) then:

$$
\begin{aligned}
R1 + R2 &= 5\text{ k-ohms}\\
R2 &= (R1 + R2)\,(V_{REF}/V_{OUT})\\
&= 5\text{ k-ohms} \times 1.3/5\\
&= 1.3\text{ k-ohms}
\end{aligned}
$$

Select $R2$ = 1.3 k-ohms and use a 10-k-ohm potentiometer for $R1$.

Parts Source

A switching-regulator kit is available to experimenters. The kit contains one Fairchild 78S40 integrated circuit, two 2213PA500-3C8 pot-core halves, and two plastic bobbins; it is available postpaid in the United States for $11.50. Only prepaid orders will be accepted. Send check or money order to:

The MicroMint, Inc
917 Midway
Woodmere NY 11598

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Editor's Note: *Steve often refers to previous Circuit Cellar articles as reference material for the articles he presents each month. These articles are available in reprint books from BYTE Books, 70 Main St, Peterborough NH 03458.* Ciarcia's Circuit Cellar *covers articles that appeared in BYTE from September 1977 through November 1978.* Ciarcia's Circuit Cellar, Volume II *presents articles from December 1978 through June 1980.*

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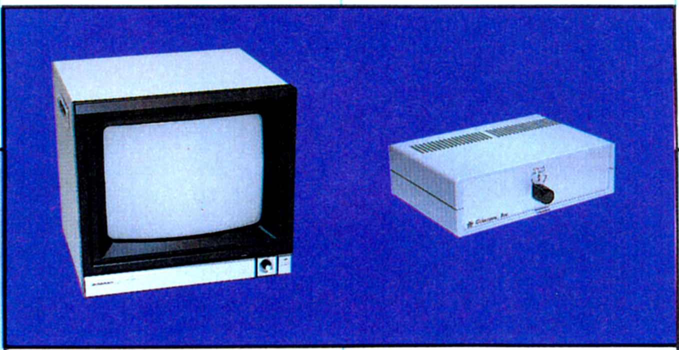

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Fundamentals of Relational Data Organization

Joel Neely and Steve Stewart
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Both mathematicians and computer scientists use the word *elegant* to describe a concept of exceptional clarity, simplicity, and utility. By those standards, the relational model of data organization is most elegant. One of the principal advantages of this model is its foundation upon a formal mathematical theory that allows its concepts to be defined and examined with great precision.

This article discusses the basic concepts of the relational approach to data organization and looks informally at the practical benefits of the model. We should point out that our emphasis is on data organization, to the exclusion of other interesting and important issues in database system design, such as the syntax and features of the data-definition and data-manipulation languages.

The Sample Data Base

As an example of the capabilities of the relational model we will use a personnel data base, which is to be developed for the use of a data-processing manager. It should contain the following information: the name of each employee (EMP), the languages that the employee is familiar with (LNG), the number of years the employee has used each language (USE), the employee's position within the organization (POS), the employee's years of experience with the company (EXP), the employee's hourly pay rate (PAY), the current project to which the employee is assigned (PRJ), and the project manager on each of these projects (MGR).

PERSONNEL1 (see table 1) shows a small sample of data that might be stored in this data base and gives the structure of the data base. (In the structure diagram headings, parentheses enclose groups of data that may be repeated, while an underline indicates *key* columns whose values identify an entire entry.)

With the design of PERSONNEL1, any request of the form:

Tell me something about employee E

may be satisfied easily. However, it is much more difficult to respond to the following requests:

List the names of all employees who use language L
Tell me the manager of project P
Display the names of all employees assigned to project P
Change the manager of project P to employee E

Through a process known as *normalization*, the organization of the data may be revised to increase the flexibility with which it can be used. Before presenting the details of this process, we need to establish some terminology.

A *relation* is a two-dimensional table (as in PERSONNEL1) consisting of horizontal rows and vertical columns. The advantage of this form is that almost everyone is familiar with data presented as a simple table. No two rows in the relation may be identical; there must be some combination of columns—a key—whose values will uniquely identify each row. In our example, we gave each employee a unique name, so EMP may be used as a key in

---

About the Authors

Joel Neely, an adjunct associate professor in the Mathematical Sciences department at Memphis State University, is president of Janus Systems, a custom software firm.

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PERSONNEL1. In practice, there may be more than one way to construct a key to a relation. Social-security number and time-clock number are values that might also be used to identify an individual employee.

Normalizing the Data

The first step in normalizing our personnel-data design is based on the following rule:

RULE 1: *For all rows, each column must take a "simple" value, ie: a single value without repetition.*

In PERSONNEL1, the columns labeled (LNG, USE) and (PRJ, MGR) are in violation of this rule, because an employee may know more than one programming language and may be assigned to more than one project. By duplicating the nonrepeating values EMP, POS, EXP, and PAY for each combination of values for the repeating groups (LNG, USE) and (PRJ, MGR), the entire relation may be represented in first normal form, as shown in PERSONNEL2 (see table 2).

Notice that in PERSONNEL2, the column EMP is no longer sufficient to identify a row. Multiple rows may be present for an employee who has more than one entry for language use or project assignment. One possible solution is to consider the combination of EMP, LNG, and PRJ as a key, since those three values together are sufficient to identify a single row.

It would appear at first that PERSONNEL2 represents a step backward, not only because it requires much more space than PERSONNEL1, but also because responding to the requests

Change employee E's position to S
Add the assignment of employee E to project P
Make employee E the manager of project P

has become much more difficult. This problem is addressed by the remaining normalization steps, which are based on the concept of *dependence*.

PERSONNEL1:

EMP	(LNG, USE)	POS	EXP	PAY	(PRJ, MGR)
Bogard	COBOL,3 FORTRAN,2	Sr Prog	4	25.00	Payroll,Smith A/R,Jonas
Dalton	COBOL,2 PL/I,1 RPG,3	Sr Prog	3	24.00	Inventory,Fitch
Fitch	COBOL,4	Prj Mgr	2	32.50	Inventory,Fitch
James	COBOL,5 GPSS,2	Sys Anl	2	29.00	A/R,Jonas Datacomm, Spivey
Jonas	AMBIT,1 BLISS,2 COBOL,1 Pascal,3	Prj Mgr	1	31.00	A/R,Jonas

Table 1: *PERSONNEL1, a sample of a personnel data base set up as a nonnormalized table.*

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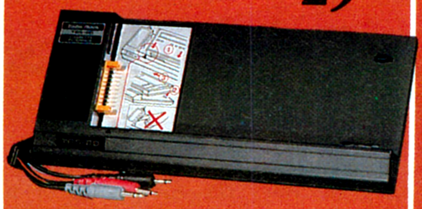

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PERSONNEL2:

EMP	LNG	USE	POS	EXP	PAY	PRJ	MGR
Bogard	COBOL	3	Sr Prog	4	25.00	Payroll	Smith
Bogard	COBOL	3	Sr Prog	4	25.00	A/R	Jonas
Bogard	FORTRAN	2	Sr Prog	4	25.00	Payroll	Smith
Bogard	FORTRAN	2	Sr Prog	4	25.00	A/R	Jonas
Dalton	COBOL	2	Sr Prog	3	24.00	Inventory	Fitch
Dalton	PL/I	1	Sr Prog	3	24.00	Inventory	Fitch
Dalton	RPG	3	Sr Prog	3	24.00	Inventory	Fitch
Fitch	COBOL	4	Prj Mgr	2	32.50	Inventory	Fitch
James	COBOL	5	Sys Anl	2	29.00	A/R	Jonas
James	COBOL	5	Sys Anl	2	29.00	Datacomm	Spivey
James	GPSS	2	Sys Anl	2	29.00	A/R	Jonas
James	GPSS	2	Sys Anl	2	29.00	Datacomm	Spivey
Jonas	AMBIT	1	Prj Mgr	1	31.00	A/R	Jonas
Jonas	BLISS	2	Prj Mgr	1	31.00	A/R	Jonas
Jonas	COBOL	1	Prj Mgr	1	31.00	A/R	Jonas
Jonas	Pascal	3	Prj Mgr	1	31.00	A/R	Jonas

Table 2: *PERSONNEL2, the data from PERSONNEL1 arranged into first normal form.*

Data Dependencies

If, for each row, the value of a column A1 uniquely determines the value of a column A2, then A2 is *functionally dependent* on A1. For example, in PERSONNEL1, since each employee has only one position we may say that EMP determines POS, and that POS is functionally dependent on EMP. If the value in column A1 limits the possible values of column A2 to a specific set, then A2 is *set dependent* on A1. PRJ is set dependent on EMP, because each employee is assigned to a specific set of projects. Figure 1 illustrates the dependencies in the sample data by using single-headed arrows to show functional dependence and double-headed arrows to show set dependence. This dependence diagram allows the problem of PERSONNEL2 to be clearly visualized.

The remaining problems are all violations of the following rule:

RULE 2: *In every row, each column must be dependent on every part of the key.*

For example, the columns POS, EXP, and PAY are not dependent on the entire key of PERSONNEL2. These

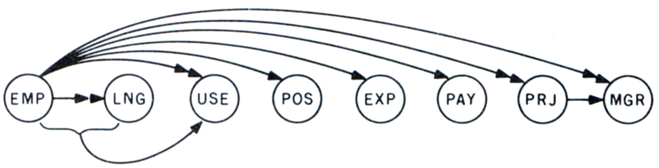
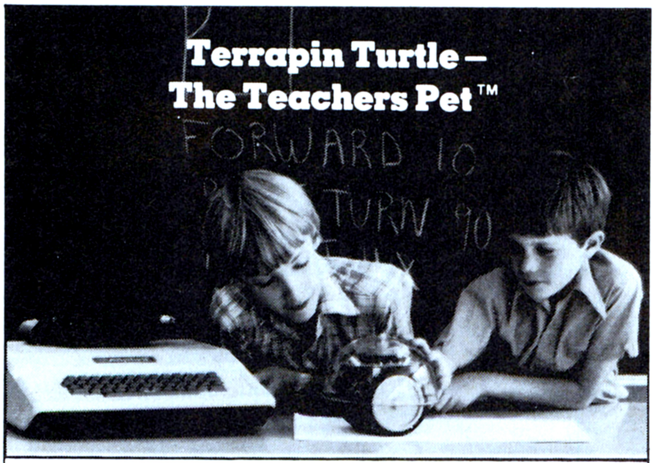


Figure 1: *This diagram illustrates the two types of data dependencies. The single-headed arrows show functional dependence and the double-headed arrows show set dependence.*



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Dalton	Sr Prog	3	24.00
Fitch	Prj Mgr	2	32.50
James	Sys Anl	2	29.00
Jonas	Prj Mgr	1	31.00

BACKGROUND:

EMP	LNG	USE
Bogard	COBOL	3
Bogard	FORTRAN	2
Dalton	COBOL	2
Dalton	PL/I	1
Dalton	RPG	3
Fitch	COBOL	4
James	COBOL	5
James	GPSS	2
Jonas	AMBIT	1
Jonas	BLISS	2
Jonas	COBOL	1
Jonas	Pascal	3

Table 3: *The data from PERSONNEL2 in second normal form. This format was achieved by splitting the relation so that there is no partial key dependence.*

columns are determined by EMP alone, so we will form a new relation, PERSONNEL3 (see table 3), containing only EMP, POS, EXP, and PAY, having EMP as a key.

The value of USE is determined by both EMP and LNG, so a BACKGROUND relation (see table 3), having a composite key made of EMP and LNG, may be formed from these three columns. Since BACKGROUND contains EMP as a column, it will still be possible to associate

PERSONNEL4:

EMP	POS	EXP	PAY
Bogard	Sr Prog	4	25.00
Dalton	Sr Prog	3	24.00
Fitch	Prj Mgr	2	32.50
James	Sys Anl	2	29.00
Jonas	Prj Mgr	1	31.00

BACKGROUND:

EMP	LNG	USE
Bogard	COBOL	3
Bogard	FORTRAN	2
Dalton	COBOL	2
Dalton	PL/I	1
Dalton	RPG	3
Fitch	COBOL	4
James	COBOL	5
James	GPSS	2
Jonas	AMBIT	1
Jonas	BLISS	2
Jonas	COBOL	1
Jonas	Pascal	3

ASSIGNMENTS:

EMP	PRJ
Bogard	A/R
Bogard	Payroll
Dalton	Inventory
Fitch	Inventory
James	A/R
James	Datacomm
Jonas	A/R

PROJECTS:

PRJ	MGR
A/R	Jonas
Datacomm	Spivey
Inventory	Fitch
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Table 4: *Our final goal—the third normal form. The data from table 3 are further split into a multi-tabular format to eliminate any transitive dependencies.*

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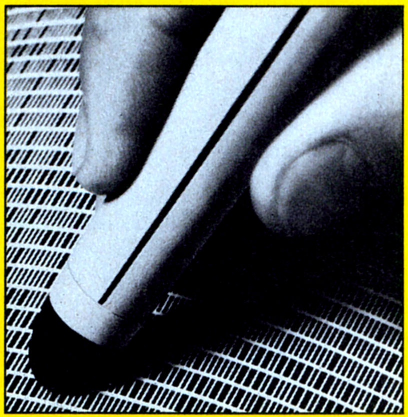

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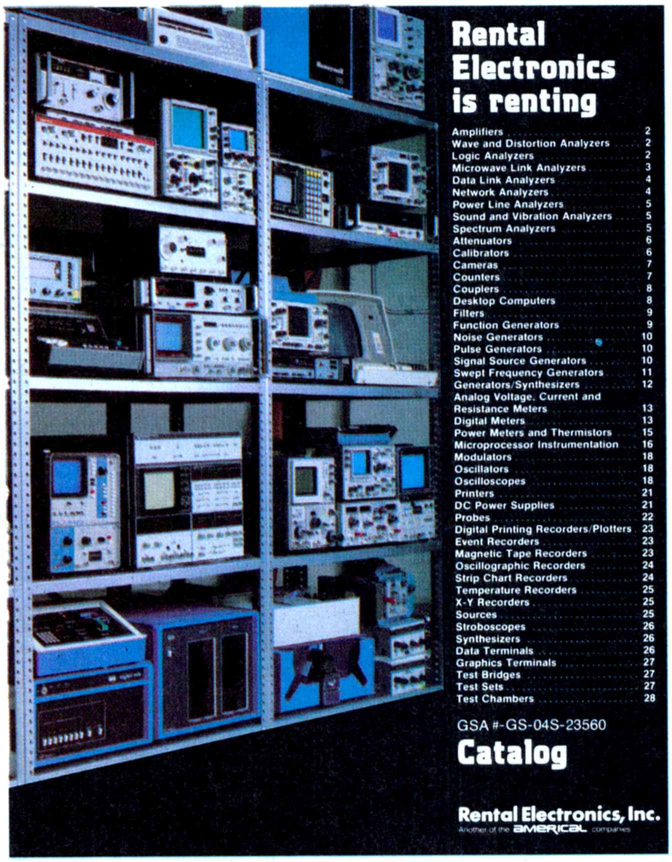

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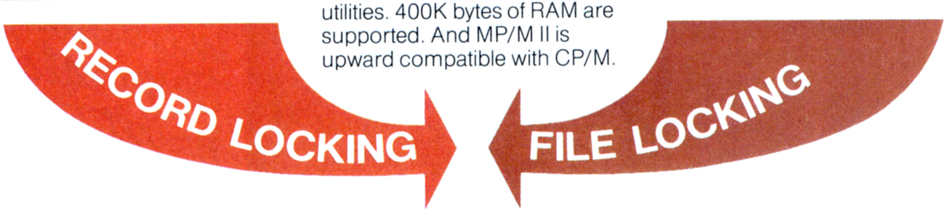

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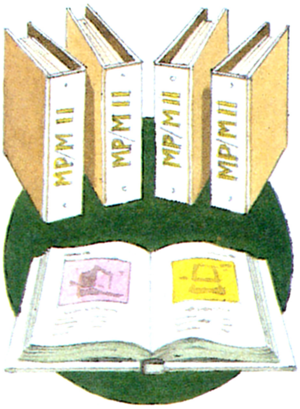

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an employee's language experience with personnel data for that employee.

Splitting the Relation

Splitting the relation, as illustrated in table 3, prevents the experience part of the model from having columns that are dependent on only part of the key. A first-normal-form relation (simple values in each position of the table) that also has no partial key dependence is said to be in second normal form.

The situation with project assignments is slightly different. The employee name determines the set of projects on which that employee works, independent of the languages used by that employee. This means that a relation containing PRJ should not have LNG in its key. However, the project name uniquely determines the project manager. MGR is *transitively dependent* on EMP, since EMP determines a set of values for PRJ, and PRJ, in turn, functionally determines MGR. This transitive dependence must also be removed, according to the following rule:

RULE 3: *In every row, all columns must depend directly on the key, without any transitive dependencies through other columns.*

Because each project has only one manager, we will form the PROJECTS relation (see table 4) from columns PRJ and MGR, using PRJ as the key. (MGR could also be a key if each employee managed only one project.)

Finally, since each employee works on one or more projects, a relation called ASSIGNMENTS (see table 4) may be constructed from EMP and PRJ to form the association between PERSONNEL3 and PROJECTS. Notice that PROJECTS is "all key" with no additional dependent columns. This is due to the fact the only thing dependent on both EMP and PRJ is the fact that they are associated. An association between relations is frequently represented in this way.

A second-normal-form relation that has no transitive dependence is said to be in third normal form. All relations in the data model of table 4 are in third normal form.

At this point, the design has evolved to the point where all of the difficult queries mentioned for the initial structure are easy to fulfill. By selecting all rows of BACKGROUND with a given value of LNG, all programmers who can use a specific language may be located. Accessing ASSIGNMENTS with a given PRJ identifies all programmers on the project. Since PROJECTS is now a separate relation, associating a project with its manager, for retrieval or change, is easy. It is equally easy to find which projects a project manager is supervising.

Using the Third Normal Form

As an example of the simplicity and flexibility of third normal form, consider the query "What is the COBOL experience of senior programmers working on any project managed by Fitch?" One approach, using the structure of table 4, would be:

1. Look in PROJECTS to find that Fitch manages the Inventory project.
2. Use ASSIGNMENTS to find that Fitch and Dalton work on Inventory.
3. From PERSONNEL4 for Fitch and Dalton, discover that Dalton is the only senior programmer.
4. Using BACKGROUND, find that Dalton has two years experience with COBOL.

By selecting one or more rows from a relation, then using column values to select from further relations, as needed, you can use the data with a high degree of flexibility. This makes it far easier to handle the unanticipated "Oh, by the way, can the computer tell me . . ." requests that invariably occur after a system has been implemented.

In Summary

Our purpose here has been to examine the data-organization aspects of the relational model. The relational concept also contains a rigorously defined set of operations that may be used to manipulate and combine relations in an algebraic fashion.

We cannot overemphasize that the relational model is concerned with a logical view of the data—apart from the physical representation used to store the data. Using only the abilities to construct multiple keys to the same data file and to find the first key greater than (or equal to) a given trial key, relational data organization may be implemented quite easily.

Although table 4 has the appearance of wasteful duplication in the stored data, a real application would likely encode all occurrences of a costly-to-store column like POS by an internal code (possibly one byte in length). Employees would most likely be identified by a unique employee code instead of by name. Thus it would be possible to have the advantages of relational organization without unreasonably high storage overhead.

In addition to the three normalization steps discussed here, there is a fourth normal form that arises in connection with certain types of complex key interdependencies. (The interested reader may find further discussion in the references.)■

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2. Kroenke, David. *Database: A Professional's Primer*. Chicago IL: SRA, 1978. Kroenke offers an interesting comparative analysis of existing commercial data-base management software.
3. Martin, James. *Computer Data-Base Organization*. Englewood Cliffs NJ: Prentice-Hall, 1977. Martin gives an excellent set of examples for the reader who is unfamiliar with data-base organization.

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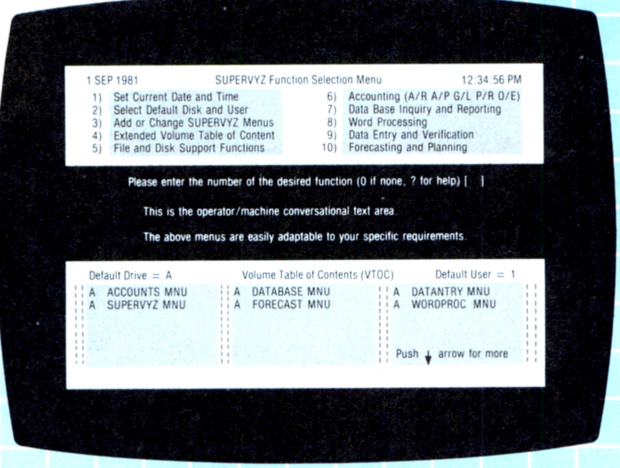

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  Default Drive = A          Volume Table of Contents (VTOC)          Default User = 1
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Build a Bar-Code Scanner Inexpensively

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Printed bar-coded software has come one step closer to being a practical reality. I began to realize this after reading an item entitled "Hewlett-Packard Introduces High-Resolution Optical Reflective Sensor" (November 1979 BYTE, "What's New" column), which announced the production of the HEDS-1000 integrated high-resolution sensor.

I waited, expecting a complete and relatively simple "scanning wand" that would be suitable for reading bar-codes. Confirmation was given on the cover of the April 1980 BYTE—Hewlett-Packard announced the HEDS-3000 Digital Wand, a fine product for those who can afford to spend $99.50. While the price is fair, as a graduate student on a fixed budget I sought a less expensive bar-code reader.

As an alternative, I constructed a homebrew bar-code scanner, based on the HEDS-1000 sensor. The do-it-yourself scanner is reliable, easily constructed, and, best of all, costs about $35 (including the $29 sensor). For those who are willing to spend time, rather than money, it represents a practical alternative to the preassembled units.

The HEDS-1000 optoreflective sensor is the eye of the scanner. Hewlett-Packard has incorporated a 700 nm (nanometer) light source, a photodiode detector, and the necessary focusing optics to detect *reflecting* and *absorbing* characters in a single package. As a bonus, the unit also includes an NPN transistor that can be optionally wired as a first single-stage high-gain amplifier. The internal connection diagram of the HEDS-1000 is illustrated in figure 1.

The only other operational requirement in addition to some elementary op-amp (operational amplifier) interfacing is that the distance between the front of the sensor and the printed page be kept at approximately 4.34 mm (0.171 inch). When set at this distance the sensor is capable of resolving a 0.190 mm (0.075 inch) spot size, which is less than half the width of a normal bar-code unit. Significant departure from this setting results in loss of resolution and, if taken to extremes, complete loss of detection.

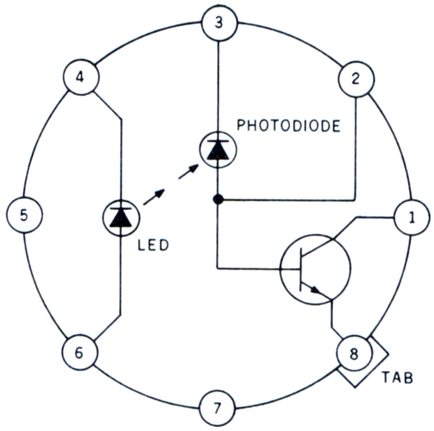

Figure 1: *Pin arrangement of Hewlett-Packard's HEDS-1000 optical reflective sensor. A light-emitting diode, photodiode, NPN transistor, and focusing optics are combined in this single package.*

In addition to these technical requirements, the sensor should be housed in a body that fits comfortably in the human hand, is easy to construct, and is (of course) inexpensive. I decided to use the body of a ball-point pen. The "fat pens" produced by a couple of manufacturers are an ideal choice. I selected the Schaefer No Nonsense pen for the wand because it provided a sufficient amount of room in the tip. Its barrel is in two pieces that screw together, and when not in use, the screw-on cap makes an excellent protective cover for the sensor.

Construction

The first step in construction involves disassembly and modification of the pen barrel. At the top of the pen is a spring, which is easily removed by drilling out from the top side. This modification becomes useful later, as it allows the scanner

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cable to exit from the top. Select a drill bit that will allow one half of a grommet to be inserted and glued into the barrel top. Slightly lower on the side of the barrel, drill a hole of similar size for the other half of the grommet, in which will be placed an LED (light-emitting diode). These modifications are shown in figure 2a. Although the indicator LED is optional, it does provide a convenient monitor of the wand's operation.

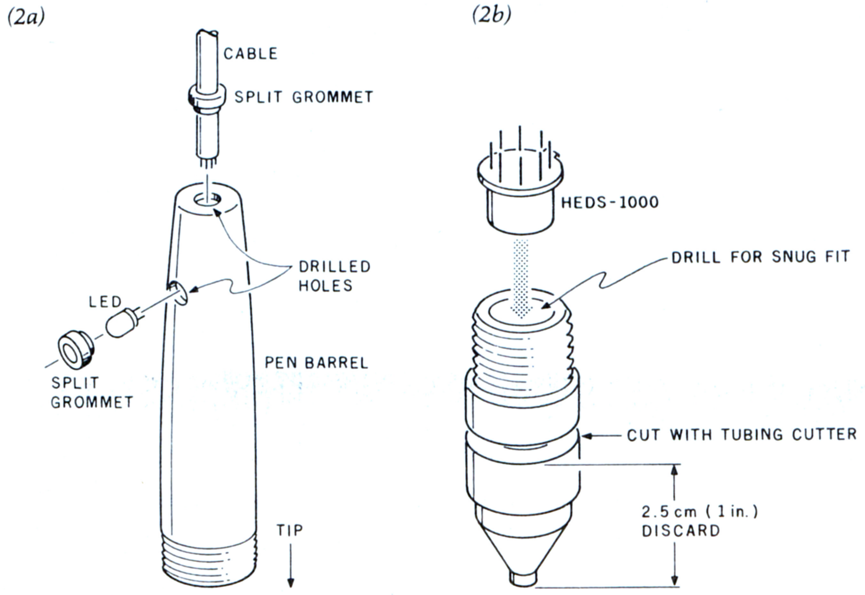

Figure 2: *Modifications made to Schaefer No Nonsense pen barrel. With contents removed, the pen becomes a home for the HEDS-1000 sensor. The cable and indicator LED are affixed to the pen barrel (2a), while the sensor is mounted to the pen tip (2b).*

A critical design factor is the number of conductors in the scanner cable. My scanner employs a five-conductor cable, which permits all interfacing to be done externally from the wand. This could have been reduced to four conductors had I placed the HEDS-1000 LED current-limiting resistor (R1) inside the barrel. In fact, I did try to place the entire circuit within the pen barrel, but it was obvious that a short circuit between pin 6 and a positive power-supply terminal was a strong possibility with such a crowded arrangement. (Burning out the LED within the sensor makes the sensor little more than an expensive phototransistor.)

If you are limited to a three-conductor cable, I suggest you eliminate the barrel-mounted indicator LED and move R1 inside the barrel. By keeping the rest of the circuitry outside of the barrel, the circuit can easily be fine tuned.

Modifications to the pen tip are shown in figure 2b. The simplest way to make a clean cut, perpendicular to the pen's axis, is with a small tubing cutter. Although not absolutely critical, the cut should be made about 2.5 cm (1.0 inch) from the tip end. This will insure that enough of the threaded part of the tip remains to securely hold the sensor while permitting adjustment of the sensor-to-reflector distance. After cutting, the threaded end of the tip should be carefully drilled out so the sensor can be pressed in snugly.

Again, it is important that the distance from the sensor's front surface to the tip's cut face be kept at approximately 4.34 mm (0.171 inch). I found this easiest to do by making a calibration cylinder exactly 4.34 mm long, which fits inside the tip opening. The diameter of the cylinder must be large enough to make contact only with the sensor's metal can, and it must not obscure the transparent filter. Successively lapping the end of

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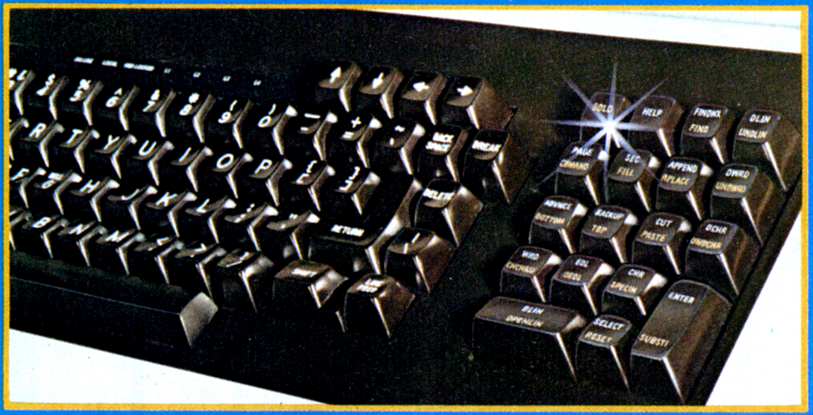

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ENGINEERING SELECTION GUIDE — FALL 1981

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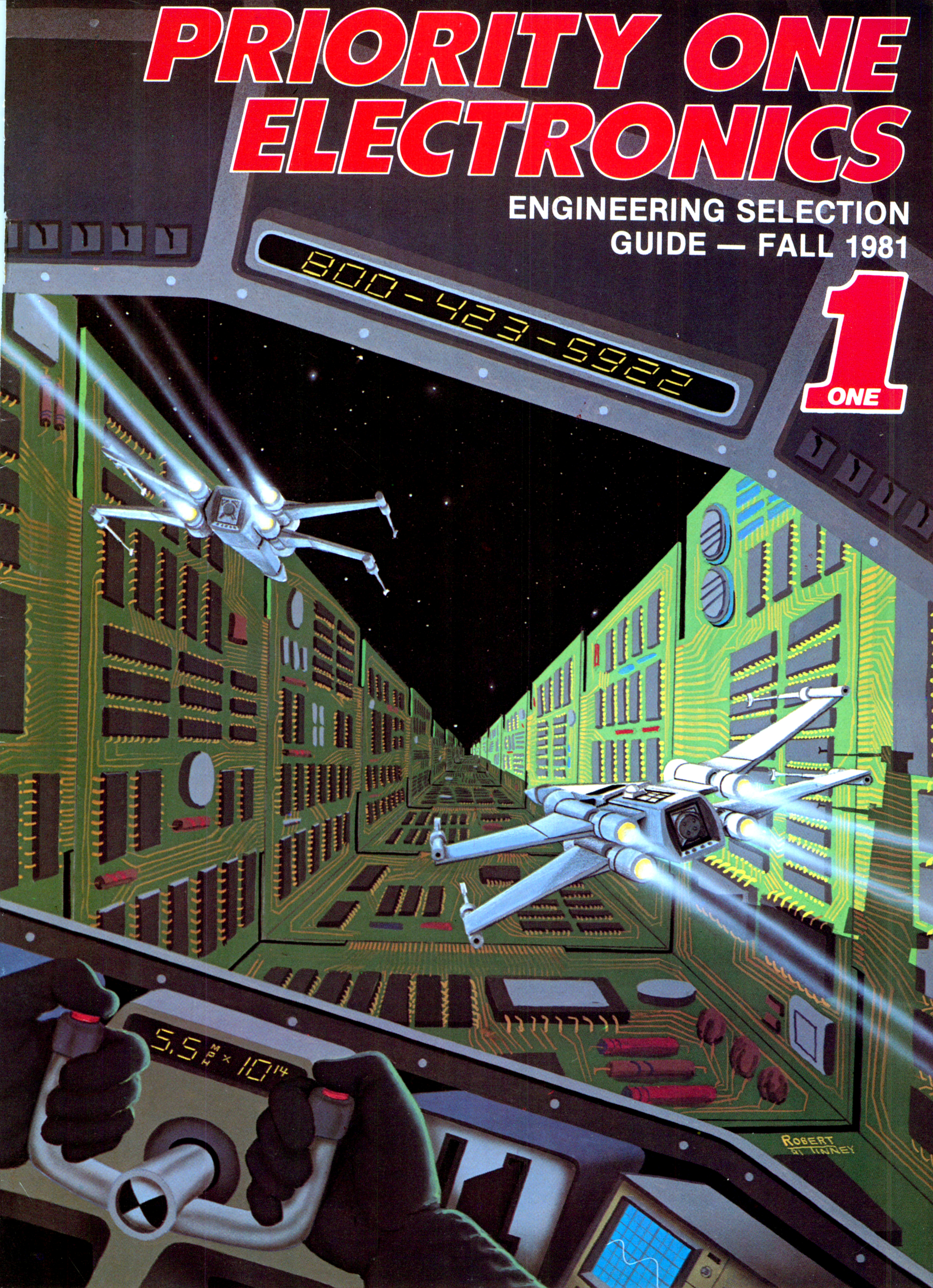
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CCS S-100 STANDARDS.

CP/M
version 2.2

CCS2200 Mainframe 12-slot motherboard minimizes noise with "double-path" trace pattern and a moveable terminator board. Power supply, circuit breaker and fan.

CCS2810 Z-80 CPU Serial I/O Port, 2K monitor ROM, 8080 control, status emulation. User-selectable ROM and serial port addresses, 2 or 4 MHz operation, power-on jump to any location in 64K.

CCS2116 16K Static Memory / CCS2032 32K Static Memory 2114 static RAMs configured to 4K, 8K or 12K (CCS2116), or 8K, 16K, or 24K (CCS2032). Bank port, bank byte select, jumper-selectable phantom and wait states, choice of 200, 300 and 450 ns RAMs.

CCS2065 64K Dynamic Memory 4116 dynamic RAMs and transparent refresh on 8080 or Z-80 based S-100 systems. Up to 512K Memory. No wait states when used with a 4MHz CPU.

CCS2710 4-Port Serial I/O Interface 4 asynchronous, software-controlled serial ports, each with 3 control registers and a 16-bit baud rate divisor latch.

CCS2718 Serial / Parallel I/O Interface 2 parallel ports, each with 4-line handshaking. 2 programmable serial ports for synchronous/asynchronous data transfer. Jumper-selectable wait states, phantom for memory overlay, parallel handshaking, serial data format.

CCS2720 4-Port Parallel I/O Interface 3 input-output ports, 1 output-only port, 8-bit parallel data transfer, 4-line-per-port handshaking, 7-bit status register, 2K of general purpose ROM.

CCS2422 Floppy Disk Controller Z80-compatible ROM bootstrap loader and monitor, 2K ROM, CP/M version 2.2 with documentation. Supports any mix of up to four 5¼" and 8", double- or single-sided, double or single density disk drives in IBM 3740 single density and System 34 double density formats.

Flexibility. Speed. Reliability. Expandability. CCS standards you can depend on as you build your S-100 system.

The same standards apply to the CCS line of Apple Modules:

CCS7114 12K ROM/PROM Module
CCS7424 Calendar/Clock Module
CCS7440 Programmable Timer
CCS7470 Analog-to-Digital Converter
CCS7490 GPIB (IEEE-488) Interface
CCS7710A Asynchronous Serial Interface
CCS7710D Asychronous Communications Interface
CCS7712 Synchronous Serial Interface
CCS7720 Parallel Interface
CCS7728 Centronics Printer Interface
CCS7811 Arithmetic Processor

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Please ***DETACH*** *this guide from your magazine and take a few moments to look over our vast selection of fine products.*

S-100 SELECTION GUIDE

S-100 CPU SELECTION GUIDE

PART NUMBER	**GBT 161A**	**GBT 1612A**	**GBT 160A**	**SSM CB1A**	**SSM CB2A**	**QTC SBC24A**	**CCS 2810A**	**GBT 161C**	**GBT 1612C**	**GBT 160C**
Page Number	(2)	(2)	(2)	(2)	(2)	(3)	(2)	(2)	(2)	(2)
Processor Type	8085	8085/88	Z-80	8080	Z-80	Z-80	Z-80	8085	8085/88	Z-80
Speed in MHz	2/5	2/6	2/4	2	2/4	2/4	2/4	2/6	8	3/6
DMA Compatible	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24 Bit Addressing	Yes	Yes	Yes	No	No	No	No	Yes	Yes	
Bank Select/Addr	DSS†	DSS†	FD	No	FE	No	Yes	DSS†	DSS†	FD
PROM Provision	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes
RAM Provision	No	No	No*	Yes	No*	Yes	No*	No	No	No
Power-On Jump	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†
Parallel Port	No	No	No	Yes	No	Yes	No	No	No	No
Serial Port	No	No	No	No	No	Yes	Yes	No	No	No
Mwrite Generation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Monitor Avail/Inc	No	No	No	Yes	Yes	Yes	Inc	No	No	No

† DSS = DIP Switch Selectable
*If board has provisions for a 2716 PROM then a 6116 RAM may be substituted.

S-100 MEMORY SELECTION GUIDE

PART NUMBER	**GBT 175A**	**GBT 164A**	**GBT 180A**	**GBT 167A**	**QTC EXP**	**CCS 2116A**	**CCS 2032A**	**CCS 2065A**	**PRI EXP1**
Page Number	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(5)
Max Size	64K	32K	64K	128K	64K	16K	32K	64K	64K
Speed in MHz	10	10	10	10	4	4	4	4	4
DMA Compatible	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
24 Bit Addressing	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Bank Select	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Type Memory Element	6116	2147	G2KX8	GBT1400	4116	2114	2114	4116	4116
Word Length (bits)	8	8	8/16	8/16	8	8	8	8	8

S-100 INTERFACE SELECTION GUIDE

PART NUMBER	**GBT 133A**	**GBT 150A**	**GBT 174A**	**CCS 2710A**	**CCS 2718A**	**CCS 2720A**	**QTC IO**	**SSM IO4**	**MDS MB3200**	**MDS SB2411**
Page Number	(6)	(6)	(6)	(7)	(6)	(6)	(7)	(7)	(7)	(7)
IEEE/S-100 Compatible	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Buffered Input/Output	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Serial Device Element	1602	1602	2651	8250	1602	N/A	8251	6011	8250	1863
Parallel Device Element	N/A	TTL	N/A	N/A	TTL	TTL	8212	8212	8259	TTL
PROM Option	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes
RAM Option	No	No	No	No	No	No	No	No	Yes	Yes
RS232 Max Baud	19.2K	19.2K	19.2K	56K	19.2K	N/A	19.2	9600	19.2K	19.2K

S-100 PROM BOARD SELECTION GUIDE

PART NUMBER	**GBT 125A**	**SSM B8A**	**SSM PB1**
Page Number	(5)	(5)	(5)
Type Memory Element	2708	2708	2708/16*
Max Memory Elements	16	16	4
Power-On Jump	Yes	Yes	No
Wait States	0-1	0-8	0-4

*Has onboard provisions for programming 2708's and 2716's

S-100 DISK CONTROLLER BOARDS

PART NUMBER	**GBT 171A**	**CCS 2422A**	**MDS DJ2208**
Page Number	(8)	(8)	(8)
Controller Device	8272	1793	1791
Number of Drives	4	4	4
PROM Provisions	Yes	Yes	No
RAM Provisions	No	No	Yes
Serial Port	Yes	No	Yes
Power-On Jump	No	No	Yes
Notes:	24 Bit DMA	Includes CP/M 2.2	Includes CP/M 2.2

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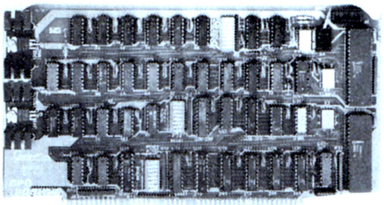

GBT161 8085 CPU BOARD
GBT1612 8085/8088 CPU BOARD

To achieve an unprecedented level of performance in a CPU board, **CPU 8085/88** includes two processors that exchange tasks to best utilize existing system capabilities. One CPU, the 8088, is an 8 bit bus version of the 8086 16 bit CPU; it has full 16 bit internal architecture, but interfaces with memory and I/O over an 8 bit bus. This approach ensures compatibility with present day machines while providing the speed and power of a true 16 bit computer. The second CPU (an 8085) is a sophisticated 8 bit processor that can run existing software such as CP/M®, and may optionally run at 2 MHz for compatibility with timing dependent software.

One look at the features listed below will show you why the **CPU 8085/88** board excels in high performance industrial, scientific and commercial applications:

- 8085 CPU is downward compatible with the vast library of 8080 software; 8088 CPU is upward compatible with 8086/8088 software, Intel's coming P-series, and other hardware and software not yet developed.
- Provides true 16 bit power with a standard 8 bit S-100 bus.
- Accesses 16 megabytes of memory.
- Fully conforms to all IEEE 696/S-100 bus specifications.
- Switches between CPUs upon receipt of a single input instruction; on-board hardware handles all pertinent switching (DMA can even occur during CPU changeover with no glitches).
- Runs both 8085 and 8088 code in existing S-100 mainframes.
- High speed operation, both CPU's run at 5MHz (Unkit), 6MHz A&T, 8MHz (CSC).
- Designed to accept clock speeds up to 8 MHz, thereby preventing obsolescence when higher speed processors become available.
- Ideal for multi-user installations.

CPU 8085/88 bridges the 8 and 16 bit worlds to give you the advantages of both modes of operation—without any of the drawbacks. For 8/16 bit software development, advanced computing systems, or multi-user setups, **CPU 8085/88** is an efficient and cost-effective gateway to the future of computing. For those who do not yet need 16 bit power, the single processor **CPU 8085** is also available; this board provides advanced 8 bit performance and may be easily upgraded to full 16 bit operation at a later date.

SPECIFICATIONS

Timing	Meets all IEEE specifications*
Clock Rate (8085)	5MHz (Unkit), 6MHz (A&T), 8MHz (CSC)
Clock Rate (8088)	5MHz (Unkit), 6MHz (A&T), 8MHz (CSC)
Address Bits	24 bits; conforms to IEEE 696/S-100 24 bit extended addressing (16 megabyte) specifications.
Memory Manager (implements extended addressing/CPU Swap	
Port Address	Address selectable by DIP switch.
Data bus	8 bits.
Power-On-Jump	DIP switch selectable to any 256 byte boundary.
Jump-On-Reset capability	Switch selectable.
I/O Wait States	One wait state (switch selectable option).
MWRITE Generator	On-board, may be switch disabled.
Front Panel Compatibility	Provided.
Method of CPU Swapping	Input instruction to swap port.
Swap Time	4 clock cycles maximum.
CLOCK (pin 49)	Always 2 MHz.
Reset Slave clr	Cenerated at power-on.

*Except 8088 clock, which exceeds the duty cycle requirements.
**6 MHz 8088 may exceed component height limits of standard size S-100 boards due to heat sinking requirements.

BOARD WITH 8085 ONLY

		List Price	Our Price
GBT161U	Unkit 5MHz		**$235.00**
GBT161A	A&T 6MHz	$324.00	**$305.00**
GBT161C	200 hr. Burn 8MHz	$425.00	**$399.00**

BOARD WITH 8085 & 8088

		List Price	Our Price
GBT1612U	Unkit 5MHz		**$295.00**
GBT1612A	A&T 6MHz	$425.00	**$399.00**
GBT1612C	200 hr. Burn 8MHz	$525.00	**$498.00**

★★★★★★★★★★★★★★★★★★★★★★★★

COMING S-100 ATTRACTIONS FROM

CompuPro division of GODBOUT

CPU8086/87 Godbout does it again with a Co-Processor board, using the 16 bit 8086 and 8087. Two processors working on the same task at the same time!! *Available December, 1981.*

CPU68K - Uses the most advanced 16 bit processor, the 68000. 16 megabyte direct addressing 32 bit internal arithmetic, 8MHz, now on the IEEE S-100 bus. *Available January, 1982.*

Please call for price and availability on these and other new **CompuPro** *products.*

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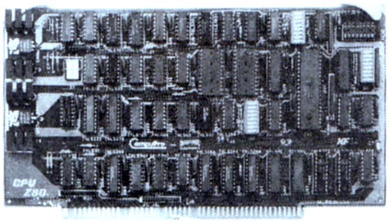


CPU-Z

The **CPU Z** board is an 8 bit workhorse that not only includes all standard Z80A* features, but also has the necessary options to ensure backward compatibility with most older S-100 mainframes. This board optionally runs at slower clock speeds if needed, generates MWRITE for systems requiring this signal, and even includes a plug that accepts the connector from an IMSAI type front panel. Other features include:

- Full compliance with all IEEE 696/S-100 specifications (including timing specifications).
- Downward compatible with the vast library of 8080 software.
- 24 bit addressing allows access to 16 megabytes of memory.
- Ideal for multi-user installations.
- Designed for high speed operation that greatly increases system throughput (switch selectable choice of 2 or 4 MHz operation for **Assembled/Tested** boards; choice of 3 or 6 MHz for boards qualified under the **CSC** high-reliability program).
- Provision for adding up to 8 kilobytes of on-board memory (2716/2732 EPROMs or 6116 RAMs—not included with board).
- On-board memory sockets may be disabled under software control to allow overlapping RAM.
- On-board fully maskable vectored interrupts for interrupt driven systems.
- Power-on clear (POC) generates SLAVE CLR* and pRESET*.
- Selectable automatic wait state insertion for servicing M1* instructions—MRQ*—I/ORQ*— or the on-board memory (may be inserted in any or all of the above).
- Automatic jump upon Reset or power-on to any 256 byte boundary.
- Non-maskable interrupt on bus pin 12, as per IEEE 696 specs.

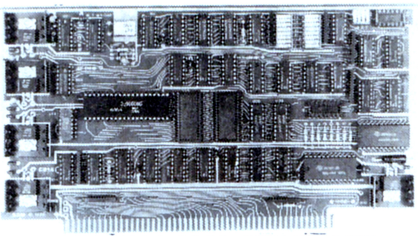
This powerful and flexible CPU board provides the sophisticated operation required by today's S-100 computers, while allowing for complete compatibility with older systems as well. But perhaps best of all, **CPU Z** is cost-competitive with boards that do considerably less. When you need a powerful 8 bit CPU board that is at home with the latest (as well as some of the earliest) S-100 systems, **CPU Z** is the answer.

SPECIFICATIONS

Timing	Meets all IEEE specifications.
Clock Rate (A/T)	2 or 4 MHz, switch selectable.
Clock Rate (CSC)	3 or 6 MHz, switch selectable.
Address Bits	24 bits; conforms to IEEE 696/S-100 extended addressing (16 megabyte) specifications.
Memory Manager (implements extended addressing)	Port FD (Hex).
Vectored Interrupt Mask	Port FE (Hex).
Data Bus	8 bits.
Power-On-Jump	DIP switch selectable to any 256 byte boundary
Jump-On-Reset Capability	Switch selectable
I/O Wait State	One wait state, switch selectable
MRQ Wait State	One wait state, switch selectable
M1 Wait State	One wait state, switch selectable
On-board Memory Wait State	One wait state, switch selectable
MWRITE Generator	On-board, can be disabled
Front Panel Compatibility	Provided on-board
CLOCK (pin 49)	Always 2 MHz
pRESET*, SLAVE CLR*	Generated by POC*(power-on-clear)

*Z80 is a trademark of Zilog.

		List Price	Our Price
GBT160U	Unkit		**$225.00**
GBT160A	A&T 2/4 MHz	$295.00	**$280.00**
GBT160C	200 hr. Burn 3/6	$395.00	**$375.00**



SSM CB1A 8080 CPU BOARD

No other 8080 CPU board can boast as many features. The CB1A has 1K bytes of scratchpad RAM on board. Provisions for 2K of on-board 2708 EPROMs may save you from ever needing a ROM card. (The ROM card is addressable at any 2K boundary.)

There is an 8 bit parallel input port, for keyboard, or up to 8 sensing lines for home or industrial control applications.

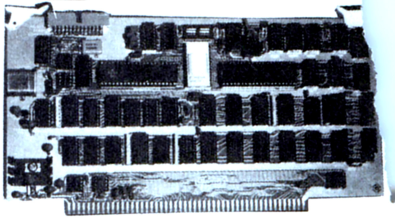
Optional power on-jump to on-board ROM eliminates the need for a front panel. And the board can generate an MWRITE signal.

This is the CPU to start with, and to grow with. With a video board or I/O board, you have a small computer, but with the capability to expand into a full-fledged S-100 system.

		List Price	Our Price
SSMCB1AK	Kit		**$183.00**
SSMCB1AA	Assembled & Tested	$252.00	**$225.00**
SSM8080M	SSM 8080 Monitor		**$ 59.00**

California Computer Systems

Z-80 SBC C



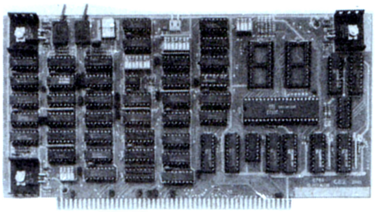
CCS2810
Z80 CPU

- 2 or 4 MHz operation, switch-selectable.
- 158 instructions, including the 8080's 78 instructions for complete 8080 software compatibility.
- On-board RS-232-C Serial Port with software-controllable handshaking, serial data format, and baud rate.
- On-board 2K monitor ROM.
- ROM and Serial Port jumper-enabled; base address of serial port jumper-selectable.
- Power-on jump to any location in 64K.
- Three LEDs indicate ROM selected, Halt state, and interrupts enabled.
- 8080 control and status signal emulation.
- Status bits available on data bus during PSYNC.
- Standard S-100 front panel control signals implemented.
- DMA Control, status, address, and data bus disable signals implemented.
- NMI, REFRESH, 2/4 MHz STATUS, and MREQ available.
- PHANTOM overlay of on-board ROM jumper-enabled.
- M1 Wait State and 8080 I/O Address Mirroring jumper-enabled.
- Separate crystals for control of CPU clock and baud rate generator.
- Full buffering of data and address lines.

		List Price	Our Price
CCS2810A	Assembled & Tested	$350.00	**$280.00**
CCS2810M	Manual		**$ 10.00**

SSM

Z80 S-100 CPU



CB2 Z-80 CPU BOARD

With over a year in design, our newest CPU board promises to be the most fully S-100 compatible Z-80 CPU on the market. It operates at 2 MHz or 4 MHz by DIP switch selection and includes two sockets for 2716 or 2732 EPROMs or HM 6116 2K RAMs. Memory sockets can be disabled. Separate run/stop and single/step switches allow system evaluation without the benefit of a front panel.

CB2 also features MWRITE for use with or without a front panel, firmware vector jump, and an output port to control 8 extended address lines allowing use of more than 65K of memory. Jumper options generate the new IEEE S-100 signals.

SPECIFICATIONS

Processor Type: Z-80
Speed: 2 MHz, 4 MHz, Mixed
On-board EPROM: Type—2716 or 2732 (not incl.) • 2048/4096 x 8 bits capacity • Dip switch addressing • Any 2K/4K boundary • One wait state added • Dip switch disable.
On-Board RAM: Type—HM 6116 (not included) • 2048 x 8 bits capacity • Dip switch addressing, 2K blocks • One wait state added • Dip switch disable.
Extended addressing: 8 additional address lines • controlled by output port FE.
Vector jump: Power on/reset firmware jump using first instruction in EPROM.
Special switches: Run/Stop and single step switches.
Additional circuitry: Jumper selected MWRITE signal • One wait per M1 or PSYNC cycle possible • Jumpers for adapting to new IEEE S-100 standard.
Buffering: All lines buffered

		List Price	Our Price
SSMCB2K	Kit		**$260.00**
SSMCB2A	Assembled & Tested	$344.00	**$310.00**
SSMZ80M	SSM Z80 Monitor		**$ 89.00**

THE HOWARD W. SAMS CRASH COURSE IN COMPUTERS

by Louis E. Frenzel, Jr. Designed to meet the computer challenge to the '80's, this course is arranged as a series of lessons in a unique self-teaching format. The programmed instructiontext is a quick and effective way to learn the basics, numbers systems, memories, architecture, input/output devices, software programming, and applications. Written for the lay person as well as scientists, engineers, or technicians. 264 pages; 8½ x 11; wirebound.

SAM 21634	**$17.50**

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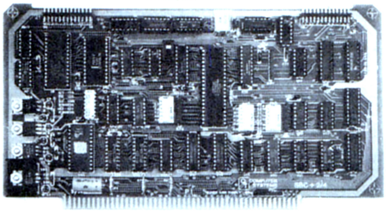

SBC2/4 Z80 S-100 SINGLE BOARD COMPUTER

The QT Computer SBC 2/4 Processor Board is a versatile and powerful Z80 based design which is compatible with the proposed IEEE S-100 bus standard. Although the SBC 2/4 may be used as the host CPU of a large system, it has all the necessary features to be used as a stand-alone computer system. The many features of this board makes it the most flexible SBC we have to offer.

TECHNICAL OVERVIEW

An on board EPROM can be addressed on any IK (2708) or 2K (2716) boundary. It is possible to use a 1K by 8 static ram in the place of the EProm if you desire. Power on jump is available directly to the EProm (or ram), at any 1K (2708) or 2K (2716) boundary. An optional wait state can be enabled for the board EProm (or ram). The on board EProm may optionally be used in shadow mode to allow the use of 64K or more of Ram. Many devices can be used in the EProm location. They are the 2708, 2716 EProms or the 4118 static ram. In addition to the EProm location, an additional 1 K of static ram is available using 2114 rams, and can be located on any 1K boundary. If the EProm is not used and the static ram is used instead of the EProm location, a total of 2K bytes of ram may be present on the CPU board.

The SBC 2/4 is equipped with a USART and a RS232 interface. The baud rate is programmable by means of a programmable timer from 110-9600 baud. All model signals required by terminal type of equipment are provided for by the CPU board and terminal equipment may be connected directly to the RS232 connector. Reverse channel capability is available for use with buffered types of devices, such as printers. The reverse channel may occasionally be needed as a busy or ready indication from the connected device, such as, out of paper or ribbon. An on board crystal provides all system timing and is switch selectable 2 or 4 MHz operation.

DMA capability is provided as well as means of having the MWRT signal generated on the CPU board or elsewhere in the system under control of DMA logic or a front panel.

There are two programmable timers available for use by programs run with the SBC 2/4. All timer outputs and controls are available for use at the parallel I/O connector. Also available for use on the CPU board, are a parallel input and a parallel output port.

All S-100 bus signals are fully buffered and regulators are used for all on board voltages to assure an electrically clean and stable design. Only top quality PC board materials is used with a solder mask on both sides, gold plated contacts and plated through holes.

- Z80A 8 bit CPU
- 2 or 4 MHz Switch selectable
- 1K RAM (which can be located at any 1K boundary)
- One parallel I/O port
- One serial I/O port
- Power on jump to on board 1K or 2K boundary
- Full 64K use of RAM allowed in shadow mode
- DMA compatibility allows MWRT signal generation on CPU board or elsewhere in system under DMA logic or front panel control
- TWO programmable timers available for use by programs run with the SBC+2/4 (timer output and controls available 'cr use on CPU board).

Shipping Weight: 2 lbs.

QTCSBC24B	Bare Board	$ 60.00
QTCSBC24K	Kit	$190.00
QTCSBC24A	Assembled & Tested	$290.00

S-100 • CLOCK CALENDAR +

The Clock/Calendar + utilizes the popular MSM5832 real time Clock/Calendar chip designed for use in bus-oriented microprocessor applications. The 32 768 Hz crystal controlled time base will provide addressable 4-bit I/O data of SECONDS, MINUTES, HOURS, DAY OF WEEK, DATE, MONTH, YEAR. The data access is controlled by a 4-bit address, read, write, and hold inputs.

Fearures Include:

- Time in Hours, Minutes, Seconds
- Program selectable 24 hour military formet of 12 hour AM/PM format
- Date in Month, Day, Year, Day of Week, and Leap Year recognition
- Fast time and date setting
- + - 30 second adjust
- 4 hard interrupts, 1024 Hz (approx 1 millisecond) 1Hz, 1 minute, 1 hour
- Crystal controlled time base
- Latched input and output ports
- On board battery backup power
- On board battery backup power
- Automatic power off sensing
- Simple programming interface

PART NO.	DESCRIPTION	PRICE
QTCCCSBB	Bare Board	$ 45.00
QTCCCSK	Kit	$100.00
QTCCCSA	A&T	$150.00
QTCCCS5D	Application Program (5¼" Disk)	$10.00

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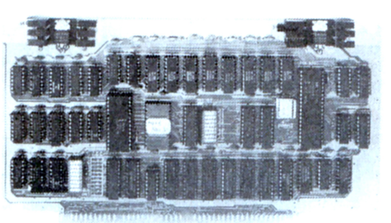

GBT166 MPX MULTIPLEXER CHANNEL BOARD

Something new on the bus! The Multiplexer Channel is a special processor board which may exist on the bus along with a CPU. The **MPX** will greatly enhance the performance of multiuser S-100 systems by relieving the CPU of much of the system I/O overhead. To accomlish this the MPX includes the following:

- 5 MHz 8085A-2 microprocessor
- 2K of ROM memory (2716 EPROM) and 4K of RAM memory on board allow the 8085 to run concurrently with CPU.
- ROM can be expanded to 4K (using 2732) or 8K (using 2764).
- RAM can be expanded to 16K (using 2167).
- An on-board interrupt controller interrupts the MPX when a device on the bus requires service.
- Full IEEE 696/S-100 temporary master interface allows the 8085 to access the bus by cycle stealing.
- DMA (Direct Memory Access) cycles may addres the full 24 bit (16 MByte) extended address range.
- DPA (Direct Port Access) cycles permit software control of all sixteen address lines allowing emulation of Z80 I/O modes.
- Fully compatible with existing interfaces.
- An Attention port is provided for the CPU to call the MPX.
- The MPX may call the CPU by generating an interrupt.
- The MPX can respond to a bus interrupt acknowledge cycle so that no other interrupt controller is required.
- The MPX may load software into its RAM from the bus allowing user flexibility and new applications.

What the above hardware capabilities boil down to is simply this: The MPX can automate the transfer of data between user programs and peripheral interfaces. Rather than interrupting the CPU every time a terminal is ready to receive a byte of data and having the CPU execute several hundred bytes of code, the MPX can transfer the same byte of data by stealing only two or three bus cycles. This results in a 98-99% reduction in CPU time wasted on this kind of overhead.

In addition to performing data transfers for serial I/O ports, the MPX may serve as a resource scheduler for high speed devices sending commands to and processing completion interrupts from high speed DMA disk controllers. Complete flexibility is provided as the MPX may load software from the bus into its on-board RAM and then execute that code allowing the function of the MPX to change dynamically as the system requires.

MPX SPECIFICATIONS

Processor: 8085A-2.
Processor Speed: 5MHz, crystal controlled.
RAM Memory: 4K - High Speed Static (local).
ROM Memory: 2K - 2716 type EPROM (local).
Interrupt Controller: 8259A, responds to VIO-7* (response is local).
S-100 Bus Address Space Required: Memory - none required. • I/O - 1 port address.
Attention Port: Used to signal MPX from Host Processor.
Port Address: Switch selectable to any of 256 I/O addresses.
DMA Cycle: Conforms to IEEE 696/S-100 specifications.
DPA Cycle: Conforms to IEEE 696/S-100 specifications.
Arbitration: Can assume any of 16 priority levels per IEEE 696/S-100 specifications, switch selectable.
Type of DMA/DPA: Single cycle, interleaved with normal bus cycles (cycle stealing).
Maximum Transfer Rate: Just Under 1 megabyte per second.
# of DMA Address Bits: 24 for memory, 16 for I/O.
Data Transfer Width: 8 bits.
Interrupt Output: MPX may signal host on either INT*, NMI* or any vectored interrupt line.
Software Supplied: ROM with standard function calls for performing lock transfers, I/O functions, interrupt handlers, etc. Also included is a function to load and run programs to/from MPX local RAM.

To use this board you must have an extensive background in Multiprocessing Techniques and Operating Systems, as the users must write extensive I/O, spooling, and system INI routines.

		List Price	Our Price
GBT166A	Assembled & Tested	$495.00	**$450.00**
GBT166C	CSC	$595.00	**$550.00**

COMPUPRO PRODUCT USER MANUALS

Action . . . suspense . . . romance . . . all of these are part of COMPUPRO's new 250 + page book, "CompuPro Product Users Manual: 1975-1981" Action? How about the torrid pace of development, as CompuPro goes from hobby memory add-on to high-class computing in less than a decade? There's Plenty of suspense, only in this book will you find the answer to the pressing question, "How do you set the dip switches on an Interfacer 2?" And what book would be complete without a touch of romance? There's a complete section on mating rituals of the S-100 bus, and how all the various signals mate with one another to create a meaningful relationship.

GBTMANUAL	WT 2lbs	$20.00

Individual CompuPro Users Manuals, Not Included in Above Book:

GBT162M	System Support 1 . 1 lb	$20.00
GBT167M	128K RAM 21, 1 lb	$10.00
GBT171M	Disk 1, 2 lbs	$25.00
GBT174M	Interfacer 3, 2 lbs	$10.00
GBT175M	64K RAM 17, 1 lb	$10.00
GBT180M	64K RAM 16, 1 lb	$10.00

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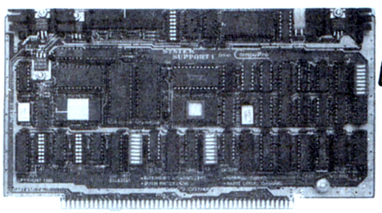
1 ONE



SYSTEM SUPPORT 1 MULTIFUNCTION BOARD

This multi-purpose S-100 board provides your computer with the most needed system support functions—at less cost than buying numerous single function boards. Includes sockets for 4K of extended address EPROM or RAM (2716 pinout), 1 socket with battery backup; crystal controlled month/day/year/time clock with BCD outputs; optional high speed math processor (8231 or 8232); full RS-232 serial port, three 16 bit interval timers (cascade or use independently); two interrupt controllers service 15 levels of interrupts; power fail indicator with provision to switch CMOS memory to battery backup; and comprehensive owner's manual with numerous software examples. Conforms fully to all IEEE 696/S-100 standards.

Want to make your S-100 system more versatile? System Support 1 is the answer.

- 4K of EPROM or RAM (2716 type).
- 15 levels of vectored interrupts.
- 3 independent 16 bit interval timers.
- Real time clock/calendar with battery backup capability.
- Full RS-232C serial port with software selectable baud rate.
- Optional high speed math processor (8231 or 8232, your choice).
- Equivalent to 9511 or 9512 but faster (4MHz vs 2MHz)
- 1, 2, 4 or 8 wait states selectable to accommodate the fastest CPUs.
- ROM/RAM can be enabled or disabled by PHANTOM.
- ROM/RAM can respond to full IEEE extended address (24 bits).

KEY SPECIFICATIONS

OPTIONAL ROM/RAM • Type used: 2716 (single supply) EPROM or equivalent, HM6116, MK4802 RAM or equivalent. • **Addressing:** Any 4K boundary, switch selectable. • **Extended Addressing:** Any page, switch selectable, can be defeated. • **PHANTOM Response:** Switch selectable; block can appear or disappear.

INTERRUPTS • **Number of levels:** 15 total, 8 from S-100 Vectored Interrupt Lines, 7 generated on-board. • **Priority:** Fixed or Rotating, software selectable. • **Interrupt Mask:** Each interrupt individually maskable. • **Polled Mode:** Available for non-interrupting systems. • **Controller Chips:** 8259A.

CLOCK CALENDAR • **Time Format:** 12 or 24 hour modes, hours, minutes, seconds, each digit individually addressable. • **Date Format:** Month, day, year, day of week; each digit individually addressable. • **Time/date set:** Each digit individually writeable. • **Battery Back-up:** 4.5 volt alkaline battery, mounts off-board. • **Battery Life:** Greater than 1.5 years.

INTERVAL TIMERS • **Number of Timers:** Three • **Timer Type:** 16 bit divide-down counter, can be cascaded. • **Input Frequency:** 2 MHz, or optional external input. • **Timer Modes:** Interrupt on Terminal Count, Programmable One-shot Rate Generator, Square Wave Generator, Software Triggered Strobe, Hardware Triggered Strobe.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
GBT162U	Unkit		$295.00
GBT162A	Assembled & Tested	$395.00	$360.00
GBT162C	CSC	$495.00	$460.00
GBT8231	Math Chip		$195.00
GBT8232	Math Chip		$195.00
GBT162AM1	A&T with 8231 Math Chip		$555.00
GBT162CM1	CSC with 8231 Math Chip		$655.00
GBT162AM2	A&T with 8232 Math Chip		$555.00
GBT162CM2	CSC with 8232 Math Chip		$655.00

Field upgrade to 8231 or 8232 from older 9511 or 9512, requires rework

S-100 LIBRARY

THE S-100 AND OTHER MICRO BUSES
by Elmer C. Poe and James C. Goodwin. From discussing the basics of buses to examining in detail the various ways to convert different bus signals to S-100 signals, this guide covers it all. 5½ x 8½, softbound.
SAM 21810 . . . . **$7.95**

INTERFACING TO S-100 (IEEE 696) MICROCOMPUTERS
by Sol Libes and Mark Garetz. This book assists S-100 users in expanding the power and utility of their systems. It describes the S-100 bus with unmatched precision and detail. Various chapters describe its mechanical and functional design, logical and electrical relationships, bus interconnections, and bussing techniques. Both parallel and serial interfacing are described as well as interfacing to RAM, ROM, and the real world. Additional chapters discuss D/A and A/D conversion, interrupts, timers and direct memory access.
GBT373 . . . . **$15.00**

THE CP/M HANDBOOK (WITH MP/M)
by Rodnay Zaks. 336 pp., 100 Illustr. Ref.
A complete guide and reference handbook for CP/M— the industry standard in operating systems. Step-by-step instruction for everything from turning on the system and inserting the diskette to correct user discipline and remedial action for problem situations. Includes a comprehensive description of all CP/M facilities and resources, instructions for advanced operations and complete discussions of all versions of CPM up to and including 2.2, MP/M and CDOS.
SBXC300 . . . . **$14.95**

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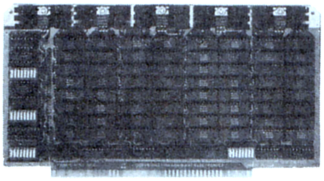
MEET THE CompuPro RAM FAMILY All S-100 RAM Boards From CompuPro Include....

Fully static memory used throughout to promote reliable operation and facilitate direct memory access (DMA).
10 MHz operation with A&T, & CSC Products.
Buffered tri-state outputs and buffered inputs.
All lines buffered; address and data lines buffered to 1 low power Schottky TTL load, all other lines buffered to less than 1 TTL load.

- Power down upon board de-select resulting in ultra low overall power consumption.
- On-board regulation.
- DIP switch address selection and deselection (no wire jumpers).
- Low power Schottky support ICs.
- S-100 boards have WRITE strobe selections switch–allows use of memory with or without front panel.
- All ICs are socketed (including support chips).
- Unique multi-block configurations for addressing flexibility.
- Industry standard board sizes.
- High quality, double sided, plate through, solder-masked and legended circuit board.
- LOW current consumption and guaranteed specs.
- 1 year parts and labor limited warranty on A&T and 2 yrs. on CSC Products.
- 1 year parts warranty on UNKIT and KIT products.

Most CompuPro Products come in 3 forms: UNKIT (U)—(this means that all sockets, disc capacitors are already soldered in place for easy assembly); fully assembled & tested (A); or qualified under the Certified System Component (C) high-reliability program (200 hour burn-in, serial numbered, immediate replacement in event of failure within 1 year of invoice date).



RAM 20 10 MHz 32K STATIC RAM

You don't have to pay a lot of money for a lot of memory: despite the surprisingly low price, **RAM 20** includes all the features that you would expect in a memory board where cost is no object. Available in 16K, 24K, and 32K configurations, **RAM 20** includes the most sought after features for any quality memory board:

- Meets or exceed all IEEE 696/S-100 specifications (including timing).
- Fully static design eliminates the timing problems associated with dynamic memories.
- Switch-selectable choice of 24 address lines conforming to the IEEE 696/S-100 extended addressing (16 megabyte) specification, or 16 address lines as used in bank select and older S-100 systems, allows **RAM 20** to support all available systems using bank select memory addressing (including Cromemco, Alpha Micro, and others) as well as newer systems conforming to the IEEE 696 extended addressing protocol.
- Ideal for multi-user installations.
- CSC and Assembled/Tested boards are deisgned for CPU speeds up to 10 MHz.
- Board is addressable as one 32K x 8 block on any 4K boundary.
- Each 4K row can be individually disabled via DIP switch.
- Switch selectable PHANTOM disable and write protect.
- +5 Volt operation (required no other supply voltages).
- Thorough bypassing of all supply lines.
- Careful thermal design to minimize heat build-up.
- Heavy power and ground traces.
- Low power operation (1200 mA typical, 1500 mA maximum).

RAM 20 delivers the high-density memory needed by every S-100 computer system - in a cost-effective and exceptionally well-designed package. Whether for 24 bit address systems or bank select systems, **RAM 20** provides economical and cost-effective mass storage.

SPECIFICATIONS

Timing	Meets all IEEE specifications.
Address Bits	24 bits; conforms to IEEE 696/S-100 extended address specifications.
Board Addressing	DIP switch selectable on any 4K boundary.
Extended Addressing	DIP switch selectable to any page.
Bank Select	DIP switch selectable port, and bit.
RAM Chips	Access time of 90 nanoseconds.
Sockets	High quality sockets provided for all ICs.
User Manual	Comprehensive, with complete circuit description, theory of operations, and schematic.
PC Board	High quality epoxy, solder masked both sides, component legend, plated through holes, gold plated edge connector fingers.
Power Consumption	1200 mA typical, 1500 mA maximum.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
GBT164AA8	8K A&T	$210.00	**$190.00**
GBT164AC8	8K CSC	$280.00	**$260.00**
GBT164AA16	16K A&T	$285.00	**$260.00**
GBT164AC16	16K CSC	$355.00	**$325.00**
GBT164AA24	24K A&T	$355.00	**$325.00**
GBT164AC24	24K CSC	$425.00	**$385.00**
GBT164AA32	32K A&T	$425.00	**$385.00**
GBT164AC32	32K CSC	$495.00	**$450.00**

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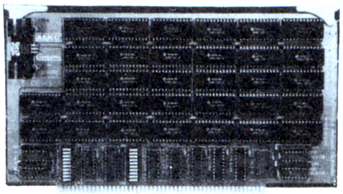

RAM 17 10 MHz 64K STATIC S-100 MEMORY

For critical high density applications where dynamic memory poses possible problems with DMA or speed, the Godbout RAM 17 64K STATIC RAM board represents the long awaited solution. Conforming fully to the IEEE 696/S-100 bus standard, RAM 17 provides 24 address lines for 16 megabytes extended addressing capability, and runs on far less power than dynamic memory.

- Meets or exceeds all IEEE 696/S-100 specifications.
- Fully static design uses less power than dynamics (2W).
- 24 bit extended addressing.
- 2K Window at E000, E800, F000, or F800 HEX (Ideal for many floppy disk controller boot proms).
- THAT'S RIGHT—64K STATIC-2 WATTS.
- Addressable as one 64Kx8 block.
- Switch selectable PHANTOM disable.
- +5V operation (requires no other power supplies).
- On board RAMs may be replaced by 2716 EPROMs (pin for pin).
- CSC and Assembled/Tested boards are designed for CPU speeds up to 10 MHz.
- Thorough bypassing of all supply lines.
- INCREDIBLE LOW POWER OPERATION (2 WATTS).
- Does DMA.
- THAT'S 2 WATTS OF STATIC 64K RAM.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
GBT175A48	48K A&T	$650.00	**$619.00**
GBT175C48	48K CSC 200 hr.	$750.00	**$710.00**
GBT175A64	64K A&T	$795.00	**$755.00**
GBT1175C64	64K CSC 200 hr.	$895.00	**$850.00**

RAM 16 10 MHz 32K x 16 BIT STATIC S-100 MEMORY

The RAM 16 has been designed for 16 bit S-100 IEEE/696 Buss use. It has all of the same features as the RAM 17, only arranged as a 32K x 16 bit wide ram board. 64K x 8 bit wide use may be used as well with the RAM 16.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
GBT180A	64K A&T	$895.00	**$850.00**
GBT180C	64K CSC	$995.00	**$945.00**

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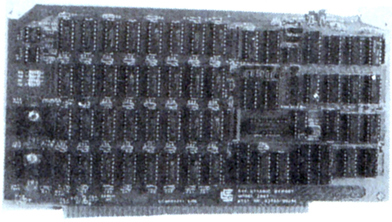

2065 64K DYNAMIC RAM MODULE

The 2065 provides your S-100 system with 64K of fast, reliable memory. Compatible with the IEEE proposed standards for the S-100 bus, the 2065 features the popular 4116-type dynamic RAMs, requires no Wait states when used with a 4 MHz CPU, and supports most front panels.

- Designed to IEEE proposed S-100 bus standards.
- Supports IMSAI-type front panels.
- Operates with either an 8080 or Z80 based S-100 system, providing processor-transparent refreshes with both.
- Bank-select system allows system memory expansion and is compatible with Cromemco products.
- Bank select port's address is jumper-selectable.
- Any 16K block can be made bank-independent.
- All 64K can be made bank-enabled on power-on and reset. Configuration as a 16K, 32K, or 48K board without the removal of RAMs.
- Fully buffered address and data lines.
- Fail-safe refresh circuitry for extended Wait states.
- Board configuration with reliable, easy-to-configure Berg jumpers.
- Supports DMA.
- Jumper-selectable Phantom input.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS20653	200nS A&T	$750.00	**$599.00**

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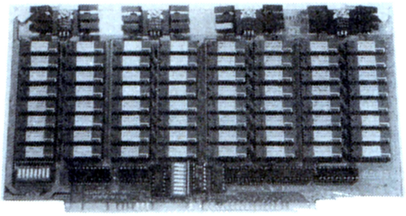

RAM 21 10 MHz 128K STATIC S-100 MEMORY

The days of "Out of Memory" are gone at last! CompuPro has introduced the largest static S-100-IEEE/696 RAM board ever to be produced.

The RAM 21 is arranged either as a 128K x 8 bit wide or 64K x 16 bit wide board, using a high speed, ultra low low power propietary static ram. CompuPro has also included 24 bit addressing for up to 16 megabyte capability and power consumption so low your mainframe will never know its there.

- Meets or exceeds all IEEE 696/S-100 specifications.
- Fully static design uses less power than dynamics (1.2 amps typical)
- 24 bit extended addressing.
- 8 bit (128K) or 16 bit (64K) operation.
- Addressable as one block.
- 16K window deselect. DIP switch selectable.
- Switch selectable PHANTOM disable.
- 10 MHz CPU operation.
- Uses a proprietary 16K x 1 static RAM, made with the Double Polysilcon NMOS process (half the power of a 2167).
- Thorough bypassing of all supply lines.
- Capable of DMA processing.
- 128K Static, 1.2 amps.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
GBT167A	128K A&T	$1695.00	**$1610.00**
GBT167C	128K CSC	$1895.00	**$1795.00**

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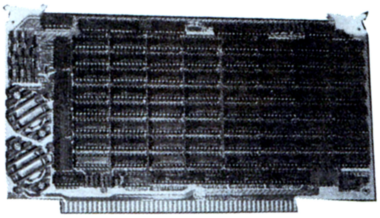

16K CCS2116 STATIC RAM

- Fully static 2114 RAMs.
- 16K of memory divided into four 4K blocks.
- Memory blocks separately addressable at 4K boundaries in 64K.
- Configurations of 4K, 8K, or 12K can be accomplished without the removal of RAMs.
- Hardware-assignment of memory blocks to any of eight memory banks using bank-port/bank-byte scheme compatible with Alpha Micro, Cromemco, and others.
- Jumper-selectable bank-independence for each memory bank.
- Fully buffered address and data lines.
- Board and bank selection indicated with LEDs.
- Jumper-enabled Phantom memory overlay and Wait state generation.
- Full QA testing of all modules at 4 MHz operation.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS21163	200nS A&T	$399.95	**$360.00**

32K CCS2032 STATIC RAM

- Fully static 2114 RAMs.
- 32K of memory divided into four 8K blocks.
- Memory blocks separately addressable at any 8K boundaries within 64K.
- Hardware-assignment of memory blocks to any of 8 memory banks using bank-port/bank-byte scheme compatible with Alpha Micro, Cromemco, and others.
- Bank-dependence of each memory block jumper-selectable.
- Bank-dependent memory can be enabled or dis-abled on reset.
- Configurations of 8K, 16K, or 24K accomplished without removal of components.
- Jumper-enabled Phantom memory overlay.
- Jumper-enabled Wait states.
- Easy-to-use Berg jumper plugs.
- Board and Bank selection indicated with LEDs.
- Compatible with IMSAI-type front panels.
- Fully buffered address and data lines.
- Full QA testing of all modules at 4 MHz.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS20323	200nS A&T	$789.00	**$699.00**

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Please ***DETACH*** *this guide from your magazine and take a few moments to look over our vast selection of fine products.*

S-100 SELECTION GUIDE

S-100 CPU SELECTION GUIDE

PART NUMBER	**GBT 161A**	**GBT 1612A**	**GBT 160A**	**SSM CB1A**	**SSM CB2A**	**QTC SBC24A**	**CCS 2810A**	**GBT 161C**	**GBT 1612C**	**GBT 160C**
Page Number	(2)	(2)	(2)	(2)	(2)	(3)	(2)	(2)	(2)	(2)
Processor Type	8085	8085/88	Z-80	8080	Z-80	Z-80	Z-80	8085	8085/88	Z-80
Speed in MHz	2/5	2/6	2/4	2	2/4	2/4	2/4	2/6	8	3/6
DMA Compatible	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24 Bit Addressing	Yes	Yes	Yes	No	No	No	No	Yes	Yes	
Bank Select/Addr.	DSS†	DSS†	FD	No	FE	No	Yes	DSS†	DSS†	FD
PROM Provision	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes
RAM Provision	No	No	No·	Yes	No·	Yes	No·	No	No	No
Power-On Jump	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†	DSS†
Parallel Port	No	No	No	Yes	No	Yes	No	No	No	No
Serial Port	No	No	No	No	No	Yes	Yes	No	No	No
Mwrite Generation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Monitor Avail./Inc	No	No	No	Yes	Yes	Yes	Inc	No	No	No

† DSS = DIP Switch Selectable

·If board has provisions for a 2716 PROM then a 6116 RAM may be substituted.

S-100 MEMORY SELECTION GUIDE

PART NUMBER	**GBT 175A**	**GBT 164A**	**GBT 180A**	**GBT 167A**	**QTC EXP**	**CCS 2116A**	**CCS 2032A**	**CCS 2065A**	**PRI EXP1**
Page Number	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(5)
Max Size	64K	32K	64K	128K	64K	16K	32K	64K	64K
Speed in MHz	10	10	10	10	4	4	4	4	4
DMA Compatible	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
24 Bit Addressing	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Bank Select	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Type Memory Element	6116	2147	2KX8	GBT1400	4116	2114	2114	4116	4116
Word Length (bits)	8	8	8/16	8/16	8	8	8	8	8

S-100 INTERFACE SELECTION GUIDE

PART NUMBER	**GBT 133A**	**GBT 150A**	**GBT 174A**	**CCS 2710A**	**CCS 2718A**	**CCS 2720A**	**QTC IO**	**SSM IO4**	**MDS MB3200**	**MDS SB2411**
Page Number	(6)	(6)	(6)	(7)	(6)	(6)	(7)	(7)	(7)	(7)
IEEE/S-100 Compatible	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Buffered Input/Output	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Serial Device Element	1602	1602	2651	8250	1602	N/A	8251	6011	8250	1863
Parallel Device Element	N/A	TTL	N/A	N/A	TTL	TTL	8212	8212	8259	TTL
PROM Option	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes
RAM Option	No	No	No	No	No	No	No	No	Yes	Yes
RS232 Max Baud	19.2K	19.2K	19.2K	56K	19.2K	N/A	19.2	9600	19.2K	19.2K

S-100 PROM BOARD SELECTION GUIDE

PART NUMBER	**GBT 125A**	**SSM B8A**	**SSM PB1**
Page Number	(5)	(5)	(5)
Type Memory Element	2708	2708	2708/16·
Max Memory Elements	16	16	4
Power-On Jump	Yes	Yes	No
Wait States	0-1	0-8	0-4

·Has onboard provisions for programming 2708's and 2716's

S-100 DISK CONTROLLER BOARDS

PART NUMBER	**GBT 171A**	**CCS 2422A**	**MDS DJ2208**
Page Number	(8)	(8)	(8)
Controller Device	8272	1793	1791
Number of Drives	4	4	4
PROM Provisions	Yes	Yes	No
RAM Provisions	No	No	Yes
Serial Port	Yes	No	Yes
Power-On Jump	No	No	Yes
Notes:	24 Bit DMA	Includes CP/M 2.2	Includes CP/M 2.2

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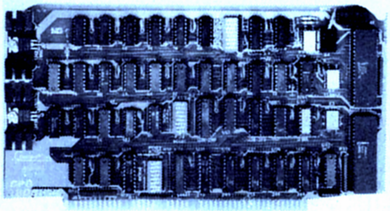
ORDER TOLL FREE (800) 423-5922

PRIORITY ONE ELECTRONICS

ONE

CompuPro™ from GODBOUT ELECTRONICS



GBT161 8085 CPU BOARD
GBT1612 8085/8088 CPU BOARD

To achieve an unprecedented level of performance in a CPU board, **CPU 8085/88** includes two processors that exchange tasks to best utilize existing system capabilities. One CPU, the 8088, is an 8 bit bus version of the 8086 16 bit CPU; it has full 16 bit internal architecture, but interfaces with memory and I/O over an 8 bit bus. This approach ensures compatibility with present day machines while providing the speed and power of a true 16 bit computer. The second CPU (an 8085) is a sophisticated 8 bit processor that can run existing software such as CP/M®, and may optionally run at 2 MHz for compatibility with timing dependent software.

One look at the features listed below will show you why the **CPU 8085/88** board excels in high performance industrial, scientific and commercial applications:

- 8085 CPU is downward compatible with the vast library of 8080 software; 8088 CPU is upward compatible with 8086/8088 software, Intel's coming P-series, and other hardware and software not yet developed.
- Provides true 16 bit power with a standard 8 bit S-100 bus.
- Accesses 16 megabytes of memory.
- Fully conforms to all IEEE 696/S-100 bus specifications.
- Switches between CPUs upon receipt of a single input instruction; on-board hardware handles all pertinent switching (DMA can even occur during CPU changeover with no glitches).
- Runs both 8085 and 8088 code in existing S-100 mainframes.
- High speed operation, both CPU's run at 5MHz (Unkit), 6MHz A&T, 8MHz (CSC).
- Designed to accept clock speeds up to 8 MHz, thereby preventing obsolescence when higher speed processors become available.
- Ideal for multi-user installations.

CPU 8085/88 bridges the 8 and 16 bit worlds to give you the advantages of both modes of operation—without any of the drawbacks. For 8/16 bit software development, advanced computing systems, or multi-user setups, **CPU 8085/88** is an efficient and cost-effective gateway to the future of computing. For those who do not yet need 16 bit power, the single processor **CPU 8085** is also available; this board provides advanced 8 bit performance and may be easily upgraded to full 16 bit operation at a later date.

SPECIFICATIONS

Timing	Meets all IEEE specifications*
Clock Rate (8085)	5MHz (Unkit), 6MHz (A&T), 8MHz (CSC)
Clock Rate (8088)	5MHz (Unkit), 6MHz (A&T), 8MHz (CSC)
Address Bits	24 bits; conforms to IEEE 696/S-100 24 bit extended addressing (16 megabyte) specifications.
Memory Manager (implements extended addressing/CPU Swap	
Port Address	Address selectable by DIP switch.
Data bus	8 bits.
Power-On-Jump	DIP switch selectable to any 256 byte boundary.
Jump-On-Reset capability	Switch selectable.
I/O Wait States	One wait state (switch selectable option).
MWRITE Generator	On-board, may be switch disabled.
Front Panel Compatibility	Provided.
Method of CPU Swapping	Input instruction to swap port.
Swap Time	4 clock cycles maximum.
CLOCK (pin 49)	Always 2 MHz.
Reset Slave clr	Cenerated at power-on.

*Except 8088 clock, which exceeds the duty cycle requirements.
**6 MHz 8088 may exceed component height limits of standard size S-100 boards due to heat sinking requirements.

BOARD WITH 8085 ONLY

		List Price	Our Price
GBT161U	Unkit 5MHz		**$235.00**
GBT161A	A&T 6MHz	$324.00	**$305.00**
GBT161C	200 hr. Burn 8MHz	$425.00	**$399.00**

BOARD WITH 8085 & 8088

		List Price	Our Price
GBT1612U	Unkit 5MHz		**$295.00**
GBT1612A	A&T 6MHz	$425.00	**$399.00**
GBT1612C	200 hr. Burn 8MHz	$525.00	**$498.00**

★★★★★★★★★★★★★★★★★★★★★★★★

COMING S-100 ATTRACTIONS FROM

CompuPro division of **GODBOUT**

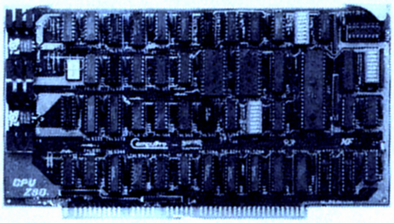
CPU8086/87 Godbout does it again with a Co-Processor board, using the 16 bit 8086 and 8087. Two processors working on the same task at the same time!! *Available December, 1981.*

CPU68K - Uses the most advanced 16 bit processor, the 68000. 16 megabyte direct addressing 32 bit internal arithmetic, 8MHz, now on the IEEE S-100 bus. *Available January, 1982.*

*Please call for price and availability on these and other new **CompuPro** products.*

★★★★★★★★★★★★★★★★★★★★★★★★

CompuPro™ from GODBOUT ELECTRONICS



CPU-Z

The **CPU Z** board is an 8 bit workhorse that not only includes all standard Z80A* features, but also has the necessary options to ensure backward compatibility with most older S-100 mainframes. This board optionally runs at slower clock speeds if needed, generates MWRITE for systems requiring this signal, and even includes a plug that accepts the connector from an IMSAI type front panel. Other features include:

- Full compliance with all IEEE 696/S-100 specifications (including timing specifications).
- Downward compatible with the vast library of 8080 software.
- 24 bit addressing allows access to 16 megabytes of memory.
- Ideal for multi-user installations.
- Designed for high speed operation that greatly increases system throughput (switch selectable choice of 2 or 4 MHz operation for **Assembled/Tested** boards; choice of 3 or 6 MHz for boards qualified under the **CSC** high-reliability program).
- Provision for adding up to 8 kilobytes of on-board memory (2716/2732 EPROMs or 6116 RAMs—not included with board).
- On-board memory sockets may be disabled under software control to allow overlapping RAM.
- On-board fully maskable vectored interrupts for interrupt driven systems.
- Power-on clear (POC) generates SLAVE CLR* and pRESET*
- Selectable automatic wait state insertion for servicing M1* instructions—MRQ*—I/ORQ*— or the on-board memory (may be inserted in any or all of the above).
- Automatic jump upon Reset or power-on to any 256 byte boundary.
- Non-maskable interrupt on bus pin 12, as per IEEE 696 specs.

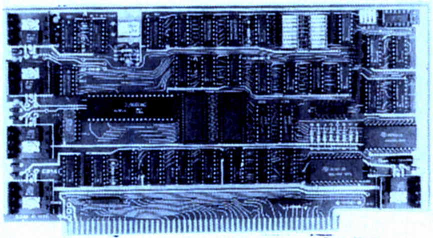
This powerful and flexible CPU board provides the sophisticated operation required by today's S-100 computers, while allowing for complete compatibility with older systems as well. But perhaps best of all, **CPU Z** is cost-competitive with boards that do considerably less. When you need a powerful 8 bit CPU board that is at home with the latest (as well as some of the earliest) S-100 systems, **CPU Z** is the answer.

SPECIFICATIONS

Timing	Meets all IEEE specifications.
Clock Rate (A/T)	2 or 4 MHz, switch selectable.
Clock Rate (CSC)	3 or 6 MHz, switch selectable.
Address Bits	24 bits; conforms to IEEE 696/S-100 extended addressing (16 megabyte) specifications.
Memory Manager (implements extended addressing)	Port FD (Hex).
Vectored Interrupt Mask	Port FE (Hex).
Data Bus	8 bits.
Power-On-Jump	DIP switch selectable to any 256 byte boundary
Jump-On-Reset Capability	Switch selectable
I/O Wait State	One wait state, switch selectable
MRQ Wait State	One wait state, switch selectable
M1 Wait State	One wait state, switch selectable
On-board Memory Wait State	One wait state, switch selectable
MWRITE Generator	On-board, can be disabled
Front Panel Compatibility	Provided on-board
CLOCK (pin 49)	Always 2 MHz
pRESET*, SLAVE CLR*	Generated by POC*(power-on-clear)

*Z80 is a trademark of Zilog.

		List Price	Our Price
GBT160U	Unkit		**$225.00**
GBT160A	A&T 2/4 MHz	$295.00	**$280.00**
GBT160C	200 hr. Burn 3/6	$395.00	**$375.00**



SSM CB1A 8080 CPU BOARD

No other 8080 CPU board can boast as many features. The CB1A has 1K bytes of scratchpad RAM on board. Provisions for 2K of on-board 2708 EPROMs may save you from ever needing a ROM card. (The ROM card is addressable at any 2K boundary.)

There is an 8 bit parallel input port, for keyboard, or up to 8 sensing lines for home or industrial control applications.

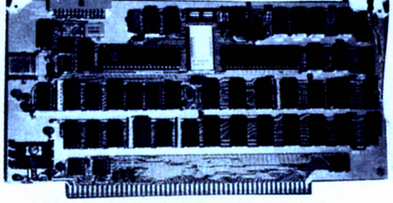
Optional power on-jump to on-board ROM eliminates the need for a front panel. And the board can generate an MWRITE signal.

This is the CPU to start with, and to grow with. With a video board or I/O board, you have a small computer, but with the capability to expand into a full-fledged S-100 system.

		List Price	Our Price
SSMCB1AK	Kit		**$183.00**
SSMCB1AA	Assembled & Tested	$252.00	**$225.00**
SSM8080M	SSM 8080 Monitor		**$ 59.00**

California Computer Systems

Z-80 SBC CPU



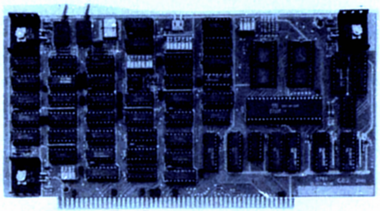
CCS2810
Z80 CPU

- 2 or 4 MHz operation, switch-selectable
- 158 instructions, including the 8080's 78 instructions for complete 8080 software compatibility.
- On-board RS-232-C Serial Port with software-controllable handshaking, serial data format, and baud rate.
- On-board 2K monitor ROM.
- ROM and Serial Port jumper-enabled; base address of serial port jumper-selectable.
- Power-on jump to any location in 64K.
- Three LEDs indicate ROM selected, Halt state, and interrupts enabled.
- 8080 control and status signal emulation.
- Status bits available on data bus during PSYNC.
- Standard S-100 front panel control signals implemented.
- DMA Control, status, address, and data bus disable signals implemented.
- NMI, REFRESH, 2/4 MHz STATUS, and MREQ available.
- PHANTOM overlay of on-board ROM jumper-enabled.
- M1 Wait State and 8080 I/O Address Mirroring jumper-enabled.
- Separate crystals for control of CPU clock and baud rate generator.
- Full buffering of data and address lines.

		List Price	Our Price
CCS2810A	Assembled & Tested	$350.00	**$280.00**
CCS2810M	Manual		**$ 10.00**

SSM

Z80 S-100 CPU



CB2 Z-80 CPU BOARD

With over a year in design, our newest CPU board promises to be the most fully S-100 compatible Z-80 CPU on the market. It operates at 2 MHz or 4 MHz by DIP switch selection and includes two sockets for 2716 or 2732 EPROMs or HM 6116 2K RAMs. Memory sockets can be disabled. Separate run/stop and single/step switches allow system evaluation without the benefit of a front panel.

CB2 also features MWRITE for use with or without a front panel, firmware vector jump, and an output port to control 8 extended address lines allowing use of more than 65K of memory. Jumper options generate the new IEEE S-100 signals.

SPECIFICATIONS

Processor Type: Z-80
Speed: 2 MHz, 4 MHz, Mixed
On-board EPROM: Type—2716 or 2732 (not incl.) • 2048/4096 x 8 bits capacity • Dip switch addressing • Any 2K/4K boundary • One wait state added • Dip switch disable.
On-Board RAM: Type—HM 6116 (not included) • 2048 x 8 bits capacity • Dip switch addressing, 2K blocks • One wait state added • Dip switch disable.
Extended addressing: 8 additional address lines • controlled by output port FE.
Vector jump: Power on/reset firmware jump using first instruction in EPROM.
Special switches: Run/Stop and single step switches.
Additional circuitry: Jumper selected MWRITE signal • One wait per M1 or PSYNC cycle possible • Jumpers for adapting to new IEEE S-100 standard.
Buffering: All lines buffered

		List Price	Our Price
SSMCB2K	Kit		**$260.00**
SSMCB2A	Assembled & Tested	$344.00	**$310.00**
SSMZ80M	SSM Z80 Monitor		**$ 89.00**

THE HOWARD W. SAMS CRASH COURSE IN COMPUTERS
by Louis E. Frenzel, Jr. Designed to meet the computer challenge to the '80's, this course is arranged as a series of lessons in a unique self-teaching format. The programmed instructiontext is a quick and effective way to learn the basics, numbers systems, memories, architecture, input/output devices, software programming, and applications. Written for the lay person as well as scientists, engineers, or technicians. 264 pages; 8½ x 11; wirebound.
SAM 21634 .... **$17.50**

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PRIORITY ONE ELECTRONICS

California Computer Systems

4-PORT SERIAL I/O INTERFACE

- Includes four individually software-controlled asynchronous serial ports.
- Meets IEEE proposed S-100 standards.
- Employs low-power Schottky devices.
- Fully buffers inputs and outputs.
- Features reliable, easy-to-configure Berg jumper plugs.

The Serial Ports:

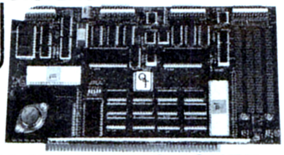
- Provide full handshaking meeting RS-232-C specifications (DCE).
- Include three control registers and three status registers per port.
- Allow clock divisors from 1 to 65535 for baud rate control.
- Double-buffer data to eliminate the need for precise synchronization.
- Allow 5 to 8 bit words: even, odd or no parity; 1, 1.5, or 2 stop bits.
- Provide false start bit detection.
- Check for parity, framing, and overrun errors.
- Separately interrupts over any of the S-100 vectored interrupt lines.
- Generate software-enabled, prioritized Transmitter Empty, Received Data, Receiver Status, and Peripheral Status interrupts.
- Perform Line Break Generation and Detection.

ROM Circuitry

- Allows on-board 2716 2K EPROM (user supplied).
- Includes jumper-configured address comparator to locate ROM at any 2K boundary.
- Controls jumper-enabled PHANTOM output for overlay of identically-addressed memory.
- Uses FF Detect to disable output when empty locations addressed.

	List Price	Our Price
CCS271001	$340.00	**$310.00**

COMPUTER SYSTEMS



S-100 MULTIFUNCTIONED I/O BOARD

Designed for industrial and business system use, the I/O+ is an excellent choice because of the many software programmable options. They allow the user with a hardware and software background to tailor the board to many applications. The large prototyping area is an added bonus to the industrial or the serious hobby user.

FEATURES:

- Two independent SYNC/ASYNC Serial Ports Software programmable with status read interface: RS-232-C or current loop (20 or 60 mA) or TTL with handshaking. Dedicated output connectors for each port.
- One strobed eight bit parallel input port with handshaking. Software status read.
- Three eight bit parallel ports (undedicated user configured). Software programmable as input, output, input with handshaking, output with handshaking, bidirectional with handshaking or combinations thereof. Software status read for handshake logic.
- Three Independent sixteen bit timers. Software programmable—five modes of operation individual clock source and input and gate control (internal or external). Uninterrupted read. Two buffered outputs.
- Eight level priority interrupt controller. Software programmable highest interrupt level. Auto restart command (8080/Z80) on interrupt acknowledge.

OTHER FEATURES:

- Large prototyping area has regulated +5 VDC, +12 VDC, -12 VDC.
- Two software programmable baud rate generators. Crystal controlled frequencies (±0.1%).

PART NO.	DESCRIPTION	PRICE
QTCIOBB	Bare Board	**$ 69.00**
QTCIOK	Kit	**$250.00**
QTCIOA	A&T	**$375.00**

★★★★★★★★★★★★★★★★★★★★★

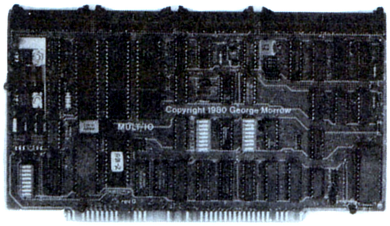
COMING SOON FROM SSM

I/05 IEEE S-100 I/O board with two serial ports, three parallel ports, timer, vectored and daisy chained interrupts. The serial ports use the 8251 UART. Two of the parallel ports use the 6821 programmable interface chip. The third parallel port is configured as a Centronics parallel port.

I/08 IEEE S-100 8 port serial interface.

Available December, 1981. Please call for price and delivery information.

MORROW DESIGNS



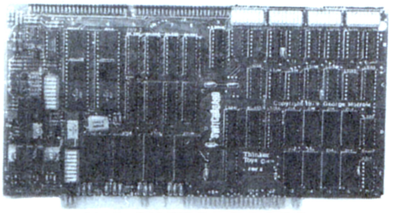
MULT I/O 3 SERIAL, 2 PARALLEL

The MULT/IO is a general purpose S-100 utility card that combines all the board level features needed to form the heart of a powerful interrupt driven, real time, multi-user system. Included on the board are three 8250 programmable ACE serial devices for communicating with RS-232 terminals or printers, an 8259-A programmable interrupt controller (PIC) capable of resolving 8 levels of maskable, prioritized interrupts and of issuing 8080/8085/z-80 call instructions as response for each level; a CMOS real time clock/calendar able to cause interrupts at software selectable intervals and with provision for battery back-up; three parallel ports (one input and two output) configured to plug directly into the ribbon cable connector of a parallel Diablo type 'Daisy Wheel' printer; 1K byte of 2708 EPROM with switch selectable wait state, and 1K byte of high speed static 2114 RAM—both RAM and EPROM being bank selectable and able to respond to all 24 S-100 address lines as defined in IEEE spec 696. The MULT/IO also provides a power-on-jump option which allows 8 bytes of code to be executed from onboard EPROM during system power-on or reset.

The serial, parallel, clock and PIC devices on the MULT/IO are all I/O mapped. These devices may be programmed to request service from the PIC based on a rich selection of status conditions. The 8259-A PIC can in turn issue to the CPU up to eight maskable, prioritized interrupt service routine call vectors. As the sole system I/O card, one MULT/IO board can be configured to support three terminals and a 'Daisy Wheel' printer while furnishing a real time, interrupt driven environment with all interrupt service routines optionally residing in on-board bank select RAM and EPROM. Alternatively, up to four MULT/IO cards may be combined to accomodate as many as twelve terminals with full interrupt support.

The on-board 8259-A interrupt controller may be jumpered to monitor any three vectored interrupt lines (S-100 bus lines 4-11) and can assert either the generalized interrupt request line (S-100 bus line 73) or any vectored interrupt line. Thus interrupts generated from off-board devices may be routed to the MULT/IO PIC can send its interrupt requests over the vectored interrupt lines to some other interrupt controller (Slave Mode).

		LIST PRICE	OUR PRICE
MDSMB3200	A&T	329.00	309.00



THE SWITCHBOARD Switch-programmable 8-port I/O Interface

SPECIFICATIONS

Eight I/O Ports: I/O ports DIP switch selectable for location on any boundary of the I/O address space divisible by 8.

Two RS232C/TTY current loop serial ports: fully independent serial ports - stop bit length selection - parity enable selection - parity even/parity odd selection - seven or eight bit word length selection - sixteen selectable baud rates from 50 to 19.2K.

One serial status port: serial port #1 — least significant 4 bits - serial port #2 — most significant 4 bits - receiver buffer full status - transmitter buffer empty status - parity error status - over-run error status.

Four Independent Parallel I/O Ports: Thirty-two lines of I/O available. Each group of eight lines DIP switch selected as input or latched output. Attention status bit for each group of eight I/O lines.

Separate STATUS Port: One latched attention status bit for each parallel I/O port. Attention bit selected by DIP switch to latch on positive or negative pulse or level. Status bit reset automatically by input reference of associated port.

Separate STROBE Port: Eight independent strobe lines. Each line DIP switch selectable to be positive or negative strobe.

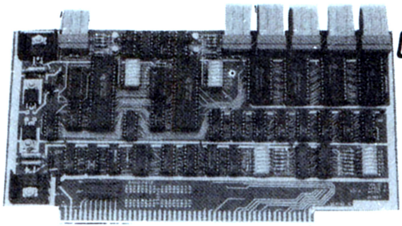
4K RAM Option: Eight 2114-3L 1Kx4 read/write static memory chips. Addressable by DIP switch on any 4K boundary. May be completely disabled via DIP switch so as to disappear from the address space of the CPU.

4K EPROM Option: Four 2708 1Kx8 erasable programmable read only memory. Addressable by DIP switch on any 4K boundary. May be completely disabled via DIP switch so as to disappear from the address space of the CPU.

Phantom Disable: DIP switch selection to allow the PHANTOM line to disable RAM and EPROM memory resident on the board.

Specifications and prices subject to change without notice.

	List Price	Our Price
MDSSB2411	$259.00	**$239.00**



I/04 2 Parallel & 2 Serial I/O Board

Two serial ports, two parallel inputs, and two parallel outputs, plus optional 134.5 BAUD for the serial interface to run most Selectrics make this an extremely popular interface board.

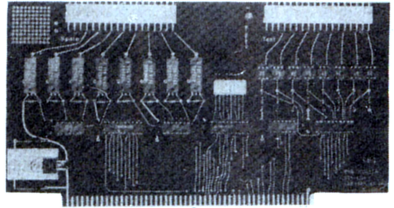
The I/04 is capable of supporting EIA (RS232) and current loop interface devices. The current loop can be optically isolated from the power supply of the mainframe.

The serial interfaces have a wide range of BAUD rates—from 55 BAUD to 9600 BAUD. Word length, parity even and odd, and number of stop bits are DIP switch selectable.

SPECIFICATIONS:

Number of parts - Two serial ports with status ● Two parallel inputs ● Two parallel outputs ● **Serial Interface** - Current-loop by optical isolators ● 20/60 ma current-loop ● EIA receivers and drivers ● 55 to 9600 baud ● 134.5 baud (optional) for running selectrics ● UART presets by dip switch: —stop bits, —word length, —parity even and odd ● + 5V, 12V & - 12V available at connector ● **Parallel Interface** - Latch type—8212 ● + 5V & - 12V available at connector ● **Addressing** - Dipswitch addressing of serial I/O to any four port boundary ● Dip switch addressing of parallel I/O to any two port boundary ● **Prototyping area** - 2 x 16 pin spare patterns.

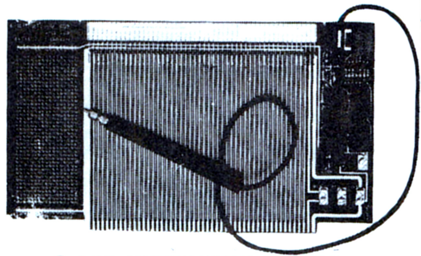
	List Price	Our Price
SSMIO4K Kit		**$210.00**
SSMIO4A A&T	**$290.00**	**$260.00**



MUL-CK011 S-100 Relay/Opto-isolator Kit

S-100 compatible, 8 fast read relays respond to an 8 bit word. Also, 8 opto-isolators accept an 8 bit word from outside and send it to your computer for handshaking or further control purposes. Good for model railroad, burglar alarm, audio switching, automated display, ham radio and other uses.

MULCK011K	Kit	**$129.00**
MULCK011	Assembled & Tested	**$179.00**



S-100 EXTENDER BOARD

Includes built-in logic probe, great instructions. Allows you to troubleshoot and work on boards outside of the system. Ideal for taking measurements; makes probing the board easy. Includes non-slip type probe. Logic probe indicates H, L, & pulse train w/3 different colored LEDs. Kit form.

MULCK004 .... **$59.00**

OB1 VECTOR JUMP & PROTOTYPING BOARD

This is an inexpensive way to implement vector jump for an 8080 to Z80 microprocessor based computer without a front panel. Activated by power-on or reset, the OB1 will vector jump to any memory location. A prototyping area is provided for user defined applications.

SPECIFICATIONS

Vector jump

- Range—65536 bytes.
- 1 byte increments.
- Dip switch selection.
- Jump with power-on/reset.
- Will work with systems not equipped with phantom disable.

Prototyping Areas

- 3 x 24/28 pin patterns.
- 10 x 16 pin patterns.
- 2 spare regulator patterns.

		List Price	Our Price
SSMOB1	Kit		**$65.00**
SSMOB1A	Assembled & Tested	$99.00	**$90.00**

VISIT OUR RETAIL SHOWROOM

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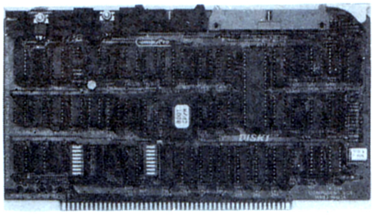


DISK 1
HIGH PERFORMANCE FLOPPY DISK CONTROLLER

Finally, a floppy disk controller worthy of bearing the **CompuPro** name is now available for integration into your S-100 system. The **DISK 1** floppy controller incorporates numerous features that were previously unavailable on a DMA floppy disk controller board. **DISK 1** fully complies with the IEEE 696 bus standard, **INCLUDING DMA ARBITRATION!**

- Third generation INTEL 8272/NEC 765A LSI floppy disk controller.
- High speed cycle stealing DMA interface for processor independent data transfer between system memory and flexible disk.
- Handles up to four 8 or 5.25 inch floppy disk drives.
- Single or double density/single or double sided capability.
- Supports IBM 3740 soft sectored formats.
- 24 bit DMA addressing with data transfer across 64K boundaries for data transfer throughout the 16Mbyte memory map.
- I/O mapped interface allows contiguous system memory. (**DISK 1** occupies no memory space)
- On board Phantom boot EPROM for automatic startup.
- On board serial port for initial system startup.
- Board compatible with MP/M, OASIS, CP/M-80 and CP/M-86.
- CPU speed independent data transfer for operation up to 10MHz.
- Fully arbitrated DMA interface as per IEEE 696 for allowing multiple DMA devices without conflict.
- May be interrupt driven for multi-user environments.
- Up to 600K bytes per side (8 inch drive) for an on-line total of up to 4.8M bytes (4 drives - double sided-double density).

All these features should convince you that **DISK 1** is the only choice when creating the highest performance S-100 disk system available - today and in the future. The **DISK 1** provides the advanced capabilities required by high performance single and multi-user microcomputer systems. Whether designing a new disk system or upgrading a lower performance disk system, **DISK 1** yields the best cost/performance ratio available today.

SPECIFICATIONS

Timing: Meets all IEEE 696 timing specifications.
Floppy Disk Controller: 3rd generation NEC 765A OR INTEL 8272.
DMA Type: Cycle stealing (releases CPU after transfer), 24 bit address, crosses 64K boundaries.
DMA Arbitration: Meets all IEEE 696 timing specifications.
Arbitration Priority: 16 switch selectable priority levels.
Port Addressing: 4 port locations required, switch selectable to any 4 port boundary in the 256 port space.
CP/M Port Requirement: Ports CO - C3H for CP/M.
BOOT EPROM: Asserts PHANTOM* line for operation, may contain up to four switch selectable boot routines of up to 256 bytes each.
Memory Requirement: Requires a 256 byte page of RAM (on page boundary at host CPU reset address) that responds to PHANTOM* for boot EPROM overlay. Controller does not occupy memory address space.
Power-On-Jump: Not required.
Serial Channel: Software controlled with standard RS-232C DCE interface pinout for startup operations.
Interrupts: Supports any of 8 vectored interrupt lines (VIO-VI7) or INT*.

DISK FORMAT AND INTERFACE
Driver Interface: Direct connection to drives with interfaces compatible with Shugart 400, 450, 800 and 850 series drives.
Drive Requirements: Up to four 5.25 or 8 inch drives supported single or double sided - single or double density.
Media Format: Supports IBM 3740 soft sectored format.
Encoding: FM or MFM - precompensated.
Sector Size: 128 byte single density, 256, 512 and 1024 byte double density.
Tracks: Will support drives with up to 256 tracks.
System Capacity: Up to 600K bytes per side, 1.2M bytes per drive, 4.8Mbytes per system (4 drives - 8 inch).
BIOS for CP/M: Provided with documentation.

		List Price	Our Price
GBT171A	Assembled & Tested	$495.00	**$450.00**
GBT171C	CSC	$595.00	**$555.00**
GBTCPM80*	CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk		**$175.00**
GBTCPM86	CP/M for 8086 with manuals & BIOS 8" S/D disk		**$300.00**

DISK 1 SOFTWARE

We strongly advise you to purchase your operating systems from Godbout that include the proper BIOS for the Disk 1. Otherwise, you will have to re-invent the wheel alone, and in the dark.

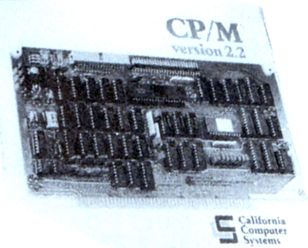
GBTCPM80	CP/M 2.2 for Z80/8085 with manuals & BIOS, 8" S/D disk	**$175.00**
GBTCPM86	CP/M for 8086 with manuals & BIOS, 8" S/D disk	**$300.00**

OASIS FROM PHASE ONE SYSTEMS, INC.

Comprehensive program development support offered by the new OASIS/Godbout system includes high level BASIC compiler and interpreter, EXEC interactive job control language, relocating macro assembler/debugger/linkage editor, and diagnostic/conversion programs.

GBTOAS8S	8 bit single user, 8" S/D disk	**$500.00**
GBTOAS8M	8 bit multi-user, 8" S/D disk	**$850.00**

California Computer Systems



MODEL 2422
FLOPPY DISK CONTROLLER

- Compatible with the IEEE proposed S-100 bus standards.
- Controls any combination of 5¼ and 8" drives up to four.
- Double-Sided and Side Select signals implemented for double-sided drives.
- Reads and writes diskettes conforming to the IBM 3740 format standard for single-density diskettes and the IBM System 34 format standard for double-density diskette.
- Z-80 compatible, ROM-resident bootstrap loader for loading CP/M into system memory from diskette.
- ROM-resident MOSS 2.2 Disk Monitor.
- Plug-compatible with Shugart 800/850 and 400/450 drives.
- Fast Seek for voice-coil drives hardware- or software-enabled.
- Can be assigned to one of eight banks through bank byte/bank port system used by Cromemco and others.
- Optional Auto Wait circuitry for wait on data or board status register when data register is not ready for data transfer.
- PINT, NMI, or VIZ-V17 can be used to interrupt the CPU when the 2422 is ready for data transfer or a new command.
- Write Precompensation circuitry for double-density diskettes.
- Digital phase locked loop for read data separation.
- LEDs to indicate ROM, Bank, and Board Select.
- Address Decoding ROMs handle ROM and register addressing.
- Optional Wait State for ROM.
- Assembled & Tested.

		List Price	Our Price
CCS2422A	With CP/M on 8" single density diskette	$475.00	**$375.00**
CCS2422A5	With CP/M on 5" single density diskette	$525.00	**$425.00**

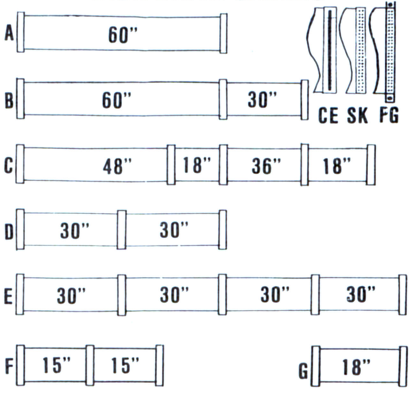
★★★★★★★★★★★★★★★★★★★★★

FOR A COMPLETE LINE OF CP/M COMPATIBLE SOFTWARE See Page 17

★★★★★★★★★★★★★★★★★★★★★

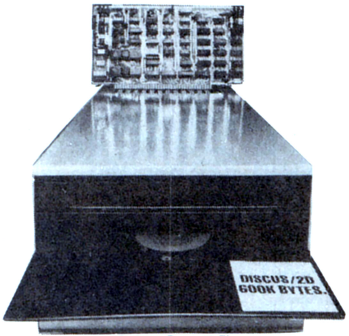
COMING SOON FROM CompuPro
Disk 2, the high speed DMA hard disk Controller

DISK DRIVE CABLES



PART #	CABLE TYPE	DISK SIZE	NO. OF DRIVES	CONNECTOR TYPE	PRICE
PRI50CECE	A	8"	1	Card Edge/Card Edge	$19.95
PRI50CESK	A	8"	1	Card Edge/Socket	$19.95
PRI50CESK	A	8"	1	Socket/Socket	$19.95
PRI50CECE2	B	8"	2	Card Edge/ 2xCard Edge	$39.95
PRI50SKCE2	B	8"	2	Socket/2xCard Edge	$34.95
PRI50SKSK2	B	8"	2	Socket/2xSocket	$34.95
PRI50SKCE4	C	8"	4	Socket/4xCard Edge	$49.95
PRI34CECE2	D	5¼"	2	Card Edge/ 2xCard Edge	$29.95
PRI34SKCE2	D	8"	2	Socket/2xCard Edge	$29.95
PRI34CECE4	E	5¼"	4	Card Edge/ 4xCard Edge	$39.95
PRI34SKCE4	E	5¼"	4	Socket/4xCard Edge	$39.95
PRI50PGCE2	F	8"	1	Plug/2x Card Edge	$34.95
PRI50PGSK	G	8"	-	Plug/Socket	$19.95
PRI34PGCE2	F	5¼"	2	Plug/2x Card Edge	$24.95
PRI34PGSK	G	5¼"	-	Plug/Socket	$14.95

MORROW DESIGNS



DISCUS/2D™
DOUBLE DENSITY DISK SYSTEM
COMPLETE WITH CP/M V2.2 AND MICROSOFT BASIC V5.2

Why not go all the way to the profesional/industrial standard of 600K byte/side disk memory with your S-100 system? The new DISCUS/2D™ full-size, double-density floppy disk system is actually less expensive than many mini-floppy systems.

And Morrow Designs™ hasn't just made full-size double-density disk memory affordable we've made it more functional.

The data format is soft-sectored and compatible with IBM's newSystem 34. And DISCUS/2D™ accepts both single-density and double-density disks for complete flexibility in data storage.

And DISCUS/2D™ is even more attractive because it's priced and delivered as a truly complete system. It's complete with all hardware. It's complete with all necessary software. And it's completely assembled, tested and warranted.

SPECIFICATIONS

- CP/M V2.2 and Microsoft Basic V5.2 Standard
- Plug compatible with Shugart, Remex and Siemens single- or double-sided drives
- Double/single-density capability utilizing MFM and FM data formats
- Western Digital 1791 LSI floppy disk controller chip
- Uses 2K of S-100 address space:
  —1K PROM with built-in disk drive and I/O utility subroutines incorporating memory mapped I/O
  —1K 2114-3L 300 ns access time RAM for disk data offering and general purpose use
- Starting address of memory space is 340 000 (E000 hex) for compatibility with other popular ROM based systems
- Phase-locked data separator and crystal controlled disk data write precompensation capability to insure the highest standards of data integrity in double density mode
- Compatible with all 2, 4 and 5 MHz systems which conform with the proposed IEEE standard for the S-100 bus
- Sixteen switch selectable baud rates from 50 to 19,200 bits/second
- TTY current loop and industry standard RS232C serial interface
- Power-on jump circuitry for automatic bootstrap loading from the disk drive
- Power supply requirements: +8V @ 1200 ma; +16V @ 150 ma; −16V @ 70 ma
- ROM utility subroutines:

Bootstrap load
Terminal input
Terminal output
Home
Disk write
Select drive
Terminal panic detect
Terminal status
Seek
Set sector
Set DMA address
Disk read
DMA status
Disk status
Disk error
Switch density

SINGLE SIDED-DISCUS 2D

PART NO.	DESCR.	SH. WT.	LIST PRICE	OUR PRICE
MDSF1218	Single Drive	30 lbs	$1095.00	**$ 950.00**
MDSF1228	Double Drive	48 lbs	$1875.00	**$1675.00**

DOUBLE SIDED-DISCUS 2+2

PART NO.	DESCR.	SH. WT.	LIST PIRCE	OUR PRICE
MDSF2218	Single Drive	30 lbs	$1395.00	**$1250.00**
MDSF2228	Double Drive	48 lbs	$2495.00	**$2200.00**

To order the above sub-systems with 220V/50Hz power supplies, add FR to the end of the above part numbers and add $35.00 per drive to the above prices.

DISK JOCKEY 2D CONTROLLER WITH CP/M* 2.2

This is the double density I/O mapped controller used in the above DISCUS sub-systems. It is offered separately for those who wish to put together their own disk packages or upgrade existing systems.

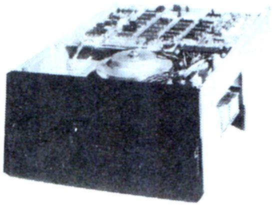
PART NO.	DESCR.	SH. WT.	LIST PRICE	OUR PRICE
MDSDJ2208	A&T with cp/M* 2.2	2 lbs	$399.00	**$375.00**

MORROW DESIGNS SOFTWARE

MDSCP/M14	For DISCUS I	**$125.00**
MDSCP/M14E	For EXIDY	**$125.00**
MDSCP/M22	Dual Density	**$150.00**
MDSMEB	Microsoft ext. basic	**$299.00**
MDSMFT	Microsoft Fortran	**$399.00**
MDSRFT	Rational Fortran	**$ 85.00**
MDSCCMP	"C" Compiler	**$600.00**
MDSREFORM	Reformatter	**$195.00**

CA, AK, HI, CALL (213) 709-5464

PRIORITY ONE ELECTRONICS



SHUGART SA801R

Capacity	Single Density	Double Density
Unformatted		
Per Disk	3.2 megabits	6.4 megabits
Per Track	41.7 kilobits	83.4 kilobits
IBM Format		
Per Disk	2.0 megabits	n/a
Per Track	26.6 kilobits	n/a
Transfer Rate	250 kilobits/sec	500 kilobits/sec.
Latency (average)	83 ms	
Access Time		
Track to Track	8 ms	8 ms
Average	260 ms	260 ms
Setting Time	8 ms	8 ms
Head Load Time	35 ms	35 ms

Shugart's SA801 standard floppy disk drive is the established industry leader with over 85,000 units installed around the world. This floppy disk drive application leadership is backed by 17 patents and a technical staff with hundreds of man-years of disk drive engineering experience.

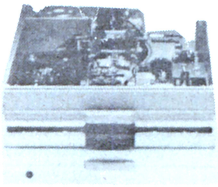
The SA801R floppy disk drive is mechanically and electronically the same as the SA801 except it has a narrower chassis width plus side and bottom mounting posts to facilitate installation of two drives side-by-side in a standard 19" RETMA rack. Shipping Weight 15 lbs.

SHU801R		**$499.00**
2 or More		**$470.00**
SHU801RM	**MANUAL** (Not included with drive)	**$10.00**

SHUGART SA400

35 Track 110 KB 5¼" disk drive, Shipping Weight 4 lbs.

SHUSA400 **$295.00**



THE DATA TRAK 8"
DOUBLE SIDED/DENSITY

The DataTrak 8 double-sided double-density drive uses state-of-the-art technology to give you superior data integrity through impoved disk life, data reliability, and drive serviceability.

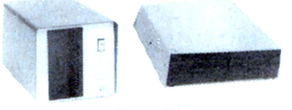
Qume's innovative approach to controlling head load dynamics yields wear characteristics far superior to competitive drives. In independent evaluation, DataTrak 8 is setting industry standards for tap test performance. This superior wear performance produces savings on both diskette usage and drive maintenance. Improved data reliability, resulting from superior amplitude and bit shift characteristics, optimizes operator efficiency and reduces processing time for end-users.

Performance Specifications

Capacity	
Unformatted	1.6 Mbytes/disk
IBM format	1.2 Mbytes/disk
Recording density	6816 BPI
Track density	48 TPI
Cylinders	77
Tracks	154
Recording Method	MFM
Rotational speed	360 RPM
Transfer rate	500K bits/sec
Latency (avg.)	83 ms
Access time	
Track-to-track	3 ms
Setting	15 ms
Average	91 ms
Head Load Time	35 ms

Shipping Weight: 15 lbs.

QME DT8		**$625.00 ea.**
2 or More		**$600.00 ea.**
QMEDT8M	Manual not included with drive	**$10.00**



SINGLE 8" DISK CABINET

Accepts one 8" disk drive (Shugart, Remex, PerSci, Siemens etc.). Fan cooled, with data cable and AC line filter to eliminate EMI. Operates from 100-125VAC/200-250VAC at 50-60Hz. Disk drive NOT included.

QTCDDC8. .... **$195.00**

Shipping Weight 22 lbs.

DUAL 8" DISK CABINET

Accepts two 8" disk drives (Shugart or size equivalent.) Fan Cooled.

QTCDDC88 24 lbs. $349.00

NEW EIGHT-INCH THIN LINE DISK DRIVES

Tandon

Tandon TM-800 Thinline is exactly half the size of conventional 8" floppy disk drives.

Tandon Corporation's new high performance, eight-inch THINLINE flexible disk drives offer single and double-sided, double density, 48 TPI. The memory capacity of word processors, small business systems, and intelligent terminals can be doubled by installing two drives in the existing cabinet space currently required by only one drive. Exceptional features are:

- Exactly one-half the height of any other model.
- Propietary, high-resolution, read-write heads patented by Tandon.
- D.C. only operation - no A.C. required.
- Industry standard interface.
- Three millisecond track-to-track access time.

MECHANICAL:

Height: 58.42mm (2.30 inches) Length: 336.55mm (13.25 inches)
Width: 217.17mm (8.55 inches)
Weight: 3.18kg (7 pounds)

ELECTRICAL:

+ 5 V.D.C. Power:	+ 5V ±5%, 1.0 amp typical
+24 V.D.C. Power:	+24V ±10%
Selected Motor On:	1.0 amp typical
Deselected:	0.1 amp typical
Spindle Motor:	0.5 amp typical

PERFORMANCE:

Number of Tracks:	77 for TM848-1 - 154 for TM848-2, 77 per surface
Track-To-Track Access Time:	3 milliseconds
Head Settling Time:	15 milliseconds
Average Access Time, including head settling time:	91 milliseconds
Motor Start Time:	0.5 second, maximum
Transfer Rates:	250K BPS single density, 500K BPS double density
IBM Formal Recording Capacity:	0.6 MBytes, single density 1.2 MBytes, double density

TNDTM8481	Single Sided **$495.00** 2 or more	**$470.00**
TNDTM8482	Double Sided **$625.00** 2 or more	**$600.00**
TNDTM8M	Manual not included with drive	**$10.00**

Tandon

TM100 SERIES 5.25"
FLOPPY DISK DRIVES

Tandon's TM100 family of 5.25" floppies offer unmatched storage capabilities in a 5¼" high-speed, random access disk drive. Available in two single-head and two double-head models, all double density, the TM100's provide unformatted storage capabilities of 250K bytes to an incredible 1000K bytes of information. The TM100 ensures maximum signal transfer and extended media life at a remarkably reasonable price due to Tandon's patented head design (one fixed and one gimbaled).

SPECIFICATIONS	**TM1001 (S.S.)** **TM1002(D.S.)**	**TM1003(S.S.)** **TM1004(D.S.)**
TPI	48	96/100
Tracks/Diskette	40	160
RPM	300	300
Capacity Per Side		
(unformatted) Double Density	250KB	500KB
Access Time		
Track-to-Track	5ms	3ms
Average	75ms	90ms
Head Settle Time	15ms	15ms
Mechanical Dimensions		
Width 5.75 in. **Height** 3.25 in. **Depth** 8.00 in.		
DC Voltage Requirements	+12/+5	+12/+5
Current Requirements	900mA/ 600mA	900mA/ 600mA

TNDTM1001	Single Sided, 250KB	**$ 310.00**
TNDTM1002	Double Sided, 500KB	**$ 370.00**
TNDTM1003	Single Sided, 500KB	**$ 375.00**
TNDTM1004	Double Sided, 1000KB	**$ 495.00**
TNDTM5M	Manual not included with drive	**$10.00**

SINGLE/DUAL
5¼" DISK CABINET

VIS9801	Single +5V @ 1A +12V @ 1.5A	**$75.00**
VIS9802	Dual +5V @ 2A +12V @ 3A	**$95.00**

8" SINGLE VERTICAL DRIVE CABINET

VIS1900 +24 @ 3A, +5 @ 2.5, -5 @ 0.5A **$295.00**

Shipping Weights: 9801 - 5 lbs., 9802 - 9 lbs., 1900 - 13 lbs.

Over the years, **Priority One Electronics** has supplied the industry with many different types of disk drive cabinets. The VISTA VISV100 is by far the most advanced design in disk drive cabinetry. The many built-in features of this cabinet make it easy and affordable, from personal to industrial applications, without sacrificing quality.

One outstanding feature: The disk drives and power supply are all mounted on a sliding sub-chassis for easy access. The bottom sub-chassis plate has holes punched out for easy disk drive configuration access.

- Features modular construction with removable sub-assembly that allows easy cabinet positioning and mounting.
- Drives pull out for easy service and maintenance.
- Deluxe chassis with internal slide allows easy access for drive positioning and mounting.
- Built to mechanically and electrically accommodate single sided drives, double sided drives—including the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape cartridge units.
- Industrial quality cabinet with die cast front bezel.
- Meets all UL and OSHA standards.
- Additional Savings! Front and rear retma rail mounts provided at no extra charge (no external slides)
- Desk or rack mountable
- Internal power and data cables.

		List Price	OUR PRICE
VISV100	Disk Drive Cabinet	**$495.00**	**$449.00**

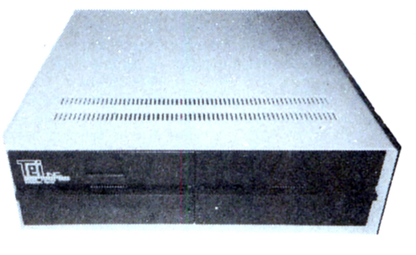
Shipping Weight: 35 lbs.

BUY THE CABINET AND SHUGART 801Rs OR QUME DT-8s AND SAVE

	with ONE drive	
PDBV100S1	With Shugart 801R	**$ 900.00**
PDBV100Q1	With Qume DT-8	**$1045.00**
	with TWO drives	
PDBV100S2	With Shugart 801R	**$1300.00**
PDBV100Q2	With Qume DT-8	**$1600.00**

Due to UPS shipping regulations, disk drives will be shipped separately from the cabinet. Don't forget to include shipping for each drive.

DiskFrame®



The TEI DiskFrame® is an enclosure designed for two Shugart SA800/801R or SA850/851R series floppy disk drives (or size compatible drives.) The DiskFramr® is constructed from 060 and 090 gauge sheet metal for rugged industrial and commercial applications. Unlike other less expensive, poorly engineered cabinets, the TEI DiskFrame® will not bend or buckle after the disk drives are installed. The DiskFrame® supply features a CVT (Constant Voltage Tranformer) for pure power. The CVT protects your system and your data from power fluctuations.

The TEI DiskFrame® is available in two models. The DFD-0 is a table top enclosure in a handsome two tone cabinet. The RFD-0 is a ruggedized rack mount 7" x 19" enclosure with chassis slides and brackets for mounting in panel racks up to 28" deep. The RFD-0 also features a lighted power switch on the front panel for easy access. The CVT power supply for both models is rated at +24V @ 1.5A, +5V @ 1A and -5V @ .25A qith an input voltage range of 85V to 140V AC. Shipping Weight: 45 lbs.

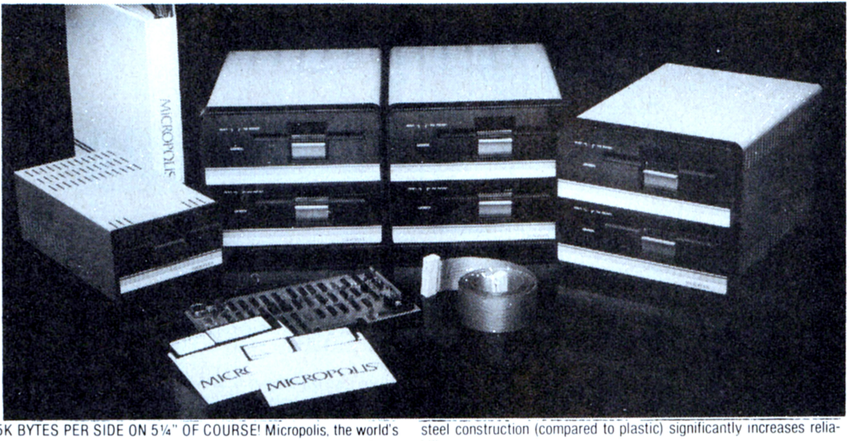
PART NO.	DESCRIPTION	LIST PRICE	OUR 1-9	PRICE 10-24
TEIDFDO	Desk Top	$535	**$485**	**$455**
TEIRFDO	Rack Mount	$720	**$670**	**$630**
RDPDFDOS1	DFDO with 1 Shugart 801R			**$970.00**
PDPDFDOS2	DFDO with 2 Shugart 801R's			**$1375.00**
PDPRFDOS1	RFDO with 1 Shugart 801R			**$1095.00**
PDPRFDOS2	RFDO with 2 Shugart 801R's			**$1495.00**
PRI50PGCE2	Internal Data Cable .50 pin plug connector to 2 Card Edge.			**$34.95**

Due to UPS shipping regulations, disk drives will be shipped separately from the cabinet. Don't forget to include shipping for each drive. (SH. WT. 16 lbs. each)

ORDER TOLL FREE (800) 423-5922

PRIORITY ONE ELECTRONICS

MICROPOLIS™ S-100 DISC DRIVE SUB SYSTEMS



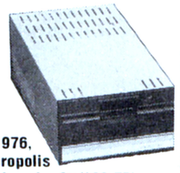
315K BYTES PER SIDE ON 5¼" OF COURSE! Micropolis, the world's largest manufacturer of high density 5 ¼" disk drives, has been doing it for years. And reliably at that.

An ordinary 5¼" floppy provides just 35 tracks per side and stores only 70K bytes. This is not nearly enough for anything useful, so Micropolis uses 77 tracks per side. Each track is then formatted with 16 sectors (hard) at 256 bytes per sector, yielding an impressive 315K bytes per side.

Micropolis drives have a larger capacity than many 8" disk drives, though they only occupy the space of a 5¼" floppy. The 315K byte capacity is roughly 4 times the capacity of a standard 5¼" drive. This is what we call QUAD DENSITY.

To achieve the high density capability, you may think Micropolis had to sacrifice speed or reliability. NOT SO! The track to track access time is only 30ms with a high speed data transfer rate of 250,000 bits per second.

By creating this high density format, Micropolis is able to keep your intial subsystem costs to a minimum. Your cost is less than $.002 per byte. That's a BIG VALUE in a small package.



In 1976, Micropolis produced a 96/100 TPI 5-¼ inch floppy disk drive.

In 1920, the Russains built a railroad stretching 5,864 miles.

No one had ever seen so many tracks before.

MICROPOLIS disk subsystems are expandable to keep up with your ever increasing needs. Up to four drives/heads may be daisy-chained on one S-100 controller board. With all four drives/heads in operation, you have access to over 1.2 MEGABYTES of on-line storage.

WITH MICROPOLIS, complete means COMPLETE. Each subsystem comes complete with controller interface, cable, and software. The software includes the MDOS operating system, extended basic, assembler and editor. MDOS is a complete package, including an assembler, editor, file management functions and utilities, which provides total support. BASIC is a self-contained package which provides a powerful set of tools for developing, testing, executing, and maintaining BASIC programs.

BASIC is designed for microcomputers with at least 24K bytes of RAM and Micropolis Meta-Floppy disk system. DOS can be used alone in a 16K byte memory system.

Activating the built-in Auto load ROM brings up the system under control fo the DOS executive. Basic can be accessed by issuing a simple DOS command.

Both packages are designed for flexible, efficient programming. Both packages use the same file structure and file management scheme for total compatibility. Programs created under DOS can be loaded and accessed from BASIC. Data files created under BASIC can be processed by user written application programs running under the DOS. Everything you need to get "On Line" in one complete package.

MICROPOLIS provides total integration, which means they control everything from beginning to end. The result is a better drive for you, backed by a full 120 days factory warranty.

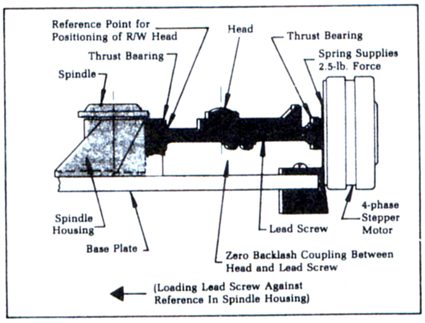
Anyone can cut price by lowering capacity or eliminating valuable features. But there's no long term advantage in it. Not for the user. Or the manufacturer.

MICROPOLIS takes a better approach, even though it's more difficult, by using advanced design to provide more capability while lowering cost.

For example, most 5¼" floppy disks cut costs by using a less expensive, less accurate plastic cam or cam follower to position the read/write head. Most 8 inch floppy disks use a better approach, with a rolled steel lead screw for this function.

Micropolis goes them one better and uses an all-steel system with a precision-ground lead screw and steel follower. A precision ground stainless steel lead screw with metal follower provides more precise positioning than the run-out sensitive pulley and belt approach used by others. Use of a four phase stepper motor and four steps per track averages the effects of all stator and rotor poles, resulting in ± 83μ-inches positional accuracy. It costs more but gives you greater storage capacity with lower cost per thousand bytes. Not so incidentally, the steel construction (compared to plastic) significantly increases reliability, too.

MICROPOLIS has a unique disk centering mechanism wherein the center of the disk fits over a profiled spindle and is clamped into place while the spindle rotates to assist centering.


Reference Point for Positioning of R/W Head
Head
Thrust Bearing
Thrust Bearing
Spring Supplies 2.5-lb. Force
Spindle
Spindle Housing
Base Plate
Lead Screw
4-phase Stepper Motor
Zero Backlash Coupling Between Head and Lead Screw
(Loading Lead Screw Against Reference In Spindle Housing)

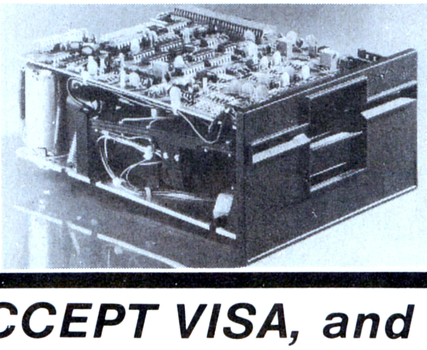
In a Micoprolis drive, the center of the diskette fits over a profiled spindle and is clamped into place while the spindle rotates to assist centering. This technique assures precise centering to within 250 μ-inches and eliminates disk crunching problems. Micropolis drives a temperature compensated. As the media expands, the preload of the leadscrew changes. The temperature compensation loop includes only the diskette, preloaded leadscrew and spindle housing. The baseplate is specifically excluded since its expansion is compensated by a proportional change in the preload of the leadscrew. This approach limits temperature variations to ±250μinches.

Micropolis strikes a balance between speed and accuracy. They chose 30ms track-to-track positioning and 250 kbps transfer rate as the optimum balance between speed on the one hand, and accuracy and reliability on the other. This speed, and the precision stainless mechanism combine to make the Micropolis drives much quieter than the band type drives that "chatter" as they move from track to track. As an added feature, there's even a builtin File Protect feature that prevents accidental loss of valuable data. (A file protected diskette cannot be written on.)

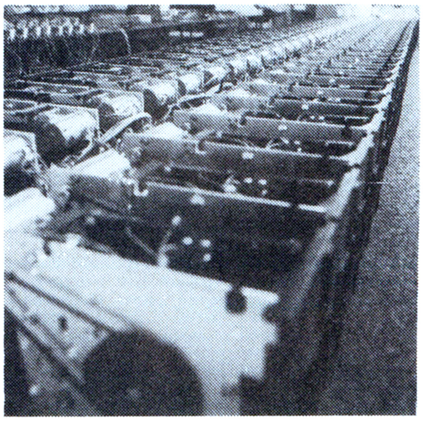
Buy a dual drive MetaFloppy and see the light. With our built-in LED that instantly indicates the drive selected, drive address, and File Protect.

SELECT
FILE PROTECT
1
ADDRESS

Heat can cause numerous read and write errors that can become hazardous to your data. The major heat producing power supply components are mounted to a large heat sink, external to the cabinet, by the power switch and fuse (located at the rear of the cabinet). This design is to assure that the drive components are kept as cool as possible to assure reliable data recovery.



MICROPOLIS has a reputation for getting along with most everybody. Compatibility is not a problem with MICROPOLIS. Their disk drives and/or subsystems can be easily integrated into systems such as Polymorphic, Cromemco, CCS, Ithaca Intersystems, Godbout, Northstar, Jade, Big Z, QT SBC 2/4, and many others. Many OEM manufacturers rely on MICROPOLIS to get the job done efficiently. In fact, to date they have delivered over 200,000 double track density drives; more than all of their competitors combined. Companies like Commodore, Exidy, Harris and Vector Graphic, to name just a few. Years from now, you can look back with a secure feeling knowing you made the best choice: MICROPOLIS.



Disk drives being assembled for delivery to Priority One Electronics.

As the world's largest distributor of MICROPOLIS SUBSYSTEMS, ***PRIORITY ONE ELECTRONICS*** is able to buy MICROPOLIS disk drives by the thousands and receive special pricing. That special pricing we receive is passed on to you in the form of tremendously discounted prices.

MICROPOLIS™

S-100 SUB-SYSTEMS

MODEL SHIP WT	CAPACITY (KBYTES)	HEADS/DRIVE TRACKS/DISKETTE	DRIVES/ ENCLOSURE POWER SUPPLY	LIST PRICE OUR PRICE
MCP1053M2 30 lbs.	630	1 77/100TPI	2 Yes	$1534.00 **$995.00**
MCP1053M4 30 lbs.	1260	2 154/100TPI	2 Yes	$1888.00 **$1395.00**
MCP1043M2 15 lbs.	150	1 77/100TPI	1 Yes	$939.00 **$695.00**
MCP1043M4 15 lbs.	630	2 154/100TPI	1 Yes	$1107.00 **$850.00**
MCP1041M2 15 lbs.	315	1 77/100TPI	1 No	$838.00 **$640.00**
MCP1041M4 15 lbs.	630	2 154/100TPI	1 No	$1005.00 **$750.00**

COMPLETE W/S-100 CONTROLLER, CABLES, MANUALS AND MICROPOLIS MDOS AND BASIC

ADD-ON DRIVES

MODEL SHIP WT	CAPACITY (KBYTES)	HEADS/DRIVE TRACKS/DISKETTE	DRIVES/ ENCLOSURE POWER SUPPLY	LIST PRICE OUR PRICE
MCP1033M2 30 lbs.	630	1 77/100TPI	2 Yes	$1301.00 **$895.00**
MCP1033M4 30 lbs.	1260	2 154/100TPI	2 Yes	$1638.00 **$1195.00**
MCP1023M2 15 lbs.	315	1 77/100TPI	1 Yes	$689.00 **$495.00**
MCP1023M4 15 lbs.	630	2 154/100TPI	1 Yes	$855.00 **$645.00**
MCP1021M2	315	1 77/100TPI	1 No	$586.00 **$439.00**
MCP1021M4	630	2 154/100TPI	1 No	$754.00 **$560.00**

NOTE: Add-on modules do not include Controller, User's Manual or Diskettes

ACCESSORIES

MCP1091-01	Regulator kit for 1041, 1021, 1015 and 1016.	**$20.00**
MCP1092-01	Relocatable bootstrap kit.	**$25.00**
MCP 1093-032	Poly 88 kit (relocated BASIC MDOS 4.0A)	**$25.00**

MANUALS

MCP1084-01	**User's Manual for Micropolis S-100 bus system.** Describes operation, configuring, installation of systems; explains details of our Disk Extended BASIC and DOS, and discusses diskette programming in general. 5 lbs. (Included with all subsystems)	**$50.00**
MCP1084-02	**Maintenance Manual** for all Micropolis floppy disk drives.	**$50.00**

DISKETTES, ETC.

VRBM0577-16	77 Track Cert. Single Side, Box 10	**$48.00**
VRBM0557-16	77 Track Cert. Double Side, Box 10	**$56.00**
VRBFD05	5¼" Head Cleaning Kit	**$29.95**

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WE ACCEPT VISA, and MASTER CARD

PRIORITY ONE ELECTRONICS

DRIVE A HARD BARGAIN!

10, 20 or 26 MEGABYTES INCLUDING CP/M 2.2* AND MICROSOFT BASIC V5.2

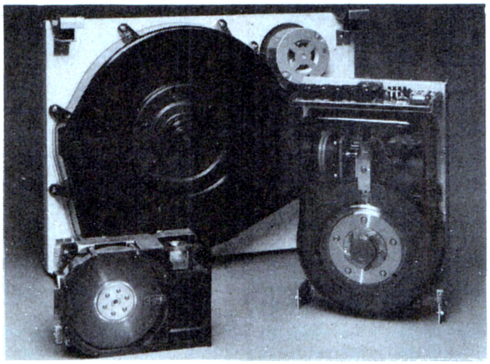
S-100 Microcompter systems can now handle 100 million bytes of storage with ease! Morrow's Designs has installed hundreds of these DISCUS 5-26 megabyte hard disk systems into every conceivable type of application.

The DISCUS M26 has 26 megabytes of useable memory on a Shugart SA 4008 Winchester style 14" sealed media hard disk drive. You can daisychain four drives on one controller for a total of 104 megabytes of on line storage.

The DISCUS M20 has 20 megabytes of useable memory on a MEMOREX 101 four platter Winchester style 8" sealed media hard disk drive. You can daisychain four drives on one controller for a total of over 80 megabytes of on line storage.

The DISCUS M10 has over 10 megabytes of useable memory on a MEMOREX 101 Winchester style 8" sealed media hard disk drive. You can daisychain four drives on one controller for a total of over 40 megabytes of on line storage.

The single-board S-100 controller incorporates intelligence to supervise all data transfers, communicating with the CPU via four I/O ports (command, two status, and data). The controller has the ability to generate interrupts at the completion of each command to increase system throughout. There is a 512 byte sector buffer on-board. Each sector can be individually write-protected for data base security.



First compare quality. Then compare cost.

GENERAL SYSTEM INFORMATION

DISCUS subsystems are supplied with the CP/M 2.2 Operating System and Microsoft V5.2 Basic prerecorded on the disk. Both low level drivers and bootstrap software are furnished in the documentation and on the disk itself. The drivers are assembled to run at F400 hex and assume that the controller has I/O addresses 50, 51, 52 and 53 hex. For recovery from a catastrophic software crash, Morrow Designs can supply a floppy diskette which reformats the disk and reinstalls copies of the operating system.

The controller can run up to four hard disks for a total of 20, 40 or 104 megabytes of on-line storage. It is implemented in forty-seven MSI and SSI TTL integrated circuits. A DIP switch is provided for setting the starting I/O address of the controller. The four addresses are:

0-Control and data status
1-Controller command register
2-Drive select and control register
3-Data In and Out

The lowest address set into the switch must be divisible by four. Through the "Drive select and control register," the controller can select any of the four drives and up to sixteen heads within a drive. Also accessible through this register are the step and direction command lines which are used to move the eight read/write heads from one track to another.

Data transfers are handled through an on-board finite state machine fashioned out of standard TTL and a medium-sized PROM (64 x 8). The commands are:

- write a sector header
- read a sector header
- read a sector of data
- write a sector of data
- reset the internal data buffer pointer to the beginning of the data buffer
- reset the internal data buffer pointer to the beginning of the sector header buffer

The CPU transfers data to the controller by first resetting the internal data buffer pointer to the beginning of either of the two data areas. Next, it fetches data from the appropriate location in memory and performs successive outputs to the data port of the controller. Each reference to the data port automatically increments the pointer to the buffer.

Transferring data from the controller is accomplished in a similar fashion. The pointer is positioned and then the CPU does successive inputs and finally stores the data in an appropriate place in memory. The data buffer is stable between operations and can be referred to again. The buffer must NOT be touched during disk data transfer operations.

Provision is made for the interconnection of controller interrupts to any of the S-100 Bus vectored or unvectored interrupts.

SPECIFICATIONS

DISCUS M26

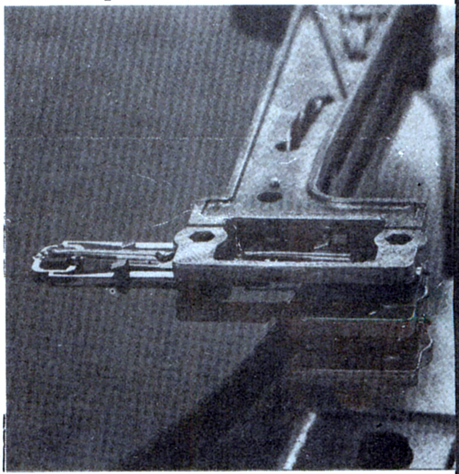
Capacity (formatted): 26,476,544 bytes
Seek time (track to track): 1 ms; head settle time: 20 ms
202 cylinders
8 tracks per cylinder
32 sectors per track
512 bytes per sector

DISCUS M10

Capacity	
Unformatted	11.7 megabytes
Formatted	10.0 megabytes
Track Capacity	12,000 bytes
Cylinder Capacity	48,000 bytes

DISCUS M20

Capacity	
Unformatted	23.4 megabytes
Formatted	20.0 megabytes
Track Capacity	12,000 bytes
Cylinder Capacity	48,000 bytes



CP/M® SOFTWARE OPTIONS

For anyone currently running CP/M 2.2, we will provide a program that automatically integrates the DISCUS M26 into the operating system. This program will be provided on an IBM standard diskette, and it will leave existing terminal and disk I/O unchanged. Thus the M26 can be readily added to most S-100 systems.

For systems without CP/M 2.2, we offer CP/M in several configurations. The standard release provides disk I/O for the DISCUS M26 and the Disk Jockey, and terminal I/O for the Disk Jockey or Switchboard serial ports. Optionally, we provide terminal I/O for the SOL keyboard and monitor or for the EXIDY keyboard and monitor. Terminal I/O can also be left blank (jump-to-self) to allow custom patching.

Finally, for CROMEMCO users, we plan to offer a CP/M 2 expanded to full CDOS compatibility and interfaced to the M26 and to standard CROMEMCO floppys. This is sold and serviced by MICAH, 1250 Pine St., #102, Walnut Creek, CA 94596, (415) 933-2783. It will also be available directly from Morrow Designs. North Star Software also available.

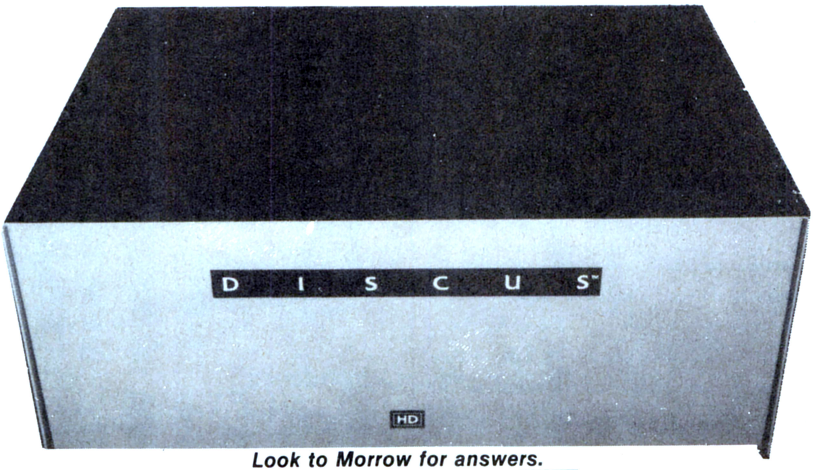
COMPLETE SUBSYSTEMS

	List Price	Our Price
MDS M10S	$3695.00	**$3200.00**
MDS M20S	$4795.00	**$3995.00**
MDS M26S	$4495.00	**$3895.00**

ADD-ON HARD DISK DRIVES

MDSM10A	$3195.00	**$2795.00**
MDSM20A	$4295.00	**$3750.00**
MDSM26A	$3995.00	**$3495.00**

Shipping Weight:	
MDS M10, 20 S & A	40 lbs.
MDS M26 S & A	50 lbs.



Look to Morrow for answers.

MORROW DESIGNS

*CP/M is a registered trademark of Digital Research

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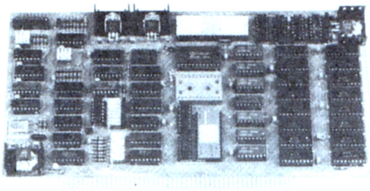
PRIORITY ONE ELECTRONICS

ONE

SSM



VB3 80 CHARACTER VIDEO BOARD

VB3 is the perfect video interface for word processing and other applications requiring 80 characters per line. It produces a standard 80 x 24 dislays or as much as 80 x 50 or a full page of text. VB3 can display upper and lower case characters, up to 256 user defined symbols, and a 160 x 200 matrix for graphics.

VB3 is memory mapped, but occupies memory only when activated. So one or more VB3s can be located at the same address with a full 65K of memory still available to the user.

It generates both US and European T.V. rates and includes a keyboard input. Software includes a CP/M compatible driver routine.

SPECIFICATIONS

Display: 80 char. per line up to 50 lines - Graphics up to 160 x 200 matrix - Upper & lower case characters - Up to 256 user defined symbols (optional EPROM) - Software controlled options: Inverted video, graphic char. (2x4), 1 level of gray, blinking char., underline, strike thru, blank-out char., cursor. 6 x 7 character EPROM.

Timing: Software controlled timing, top & bottom margins, horiz. position - U.S. & European T.V. timing - Full interlace or non-interlace - Crystal — 16 MHz (dot rate)

Interface: Composite video, =75 OHM - Verti./horiz. drive output & sync input - Memory mapped

Keyboard: Keyboard port with status - Dip switch addressing of ports

On-board RAM: 4096 Bytes (8192 bytes optional) - 2114L (250 nsec or 450 nsec) - Switch addressing, 8K increments - On-board bank-select of RAM

Buffering: All lines buffered

Software: CP/M compatible drive routine - Powerful terminal simulator routine

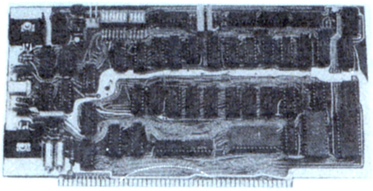
		List Price	Our Price
SSMVB3K24	80x24 KIT		**$425.00**
SSMVB3A24	80x24 A&T	$499.00	**$440.00**
SSMVB3UP	80x50 Line Upgrade Kit		**$ 39.00**

Video Interface Software

CP/M Compatible 8" Disk, containing

- CP/M BIOS Driver
- Inteligent terminal driver to emulate Televideo CRT's.
- Super Intelligent Terminal Routines
- Graphics Routine
- Menu-Driven Initialization Routine
- Misc. User - Contributed Programs

		Our Price
SSMVB3SOFT	Video Interface Software	**$50.00**



VB2 I/O MAPPED VIDEO BOARD

The VB2 is an I/O controlled video interface board. With a TV monitor, the VB2 becomes a video terminal. No other I/O card is required for keyboard input and video display.

The VB2 cursor, linefeed, carriage return, backspace, and clear-screen are hardware controlled. The display is 64 x 16, all upper case, and is selectable for white on black, or black on white. The board produces a clear, bright display, and features adjustable picture size and character width. Circuitry is provided to drive a speaker for a tone.

SPECIFICATIONS

Display: 64 characters per line by 16 lines - Switch selected black-on-white or white-on-black display - Upper case characters - Underline shaped cursor - Hardware line feed, carriage return and backspace - Full interlace for better TV compatibility - U.S. TV standard frequencies - Crystal—14.318 MHz - Adjustable horizontal margin - Adjustable character width - Switch selectable vertical position.

Interface: Composite video 75 ohm - External sync inputs for slave control of VB2 - I/O mapped board - Parallel keyboard input - Positive or negative keyboard status - Full duplex - Dip switch selection of any port address - Drive for external beep tone

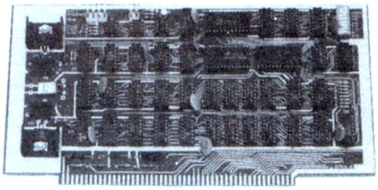
		List Price	Our Price
SSMVB2K	KIT		**$199.00**
SSMVB2A	Assembled & Tested	$269.00	**$229.00**

COMPUTER GRAPHICS PRIMER

by Mitchell Waite. Three carefully illustrated chapters explain perspectives, basic concepts, and graphics programming in this newest computer and graphics programming in this newest computer development that permits the creation of complex drawings, plans, maps, and schematics on the screen of a television set. 184 pages; 5½ x 8½; softbound.

SAM 21650. . . . . $12.95

SSM



VB1C MEMORY MAPPED VIDEO BOARD

One of the most popular S-100 video boards available, this VBIC is software controlled and memory mapped. Memory Mapping means that locations in the 1K (1024 byte) on-board RAM memory correspond with locations in the 64 x 16 (1024) character display.

The 1K memory can be addressed at any 1K increment via DIP switch.

The VBIC features a 128 x 48 matrix for graphics upper and lower case, Greek letters, and black on white or white on black. Software includes a driver routine for cursor control, scroll-up, and X-Y graphic control.

The Board can be used with a modified television or commercially available monitor.

SPECIFICATIONS

Display: 64 or 32 characters per line - 16 lines - Graphics (128 x 48 matrix) - Upper case, lower case & Greek characters - Black-on-white, and white-on-black - 8% horizontal margins - 6% upper vertical margins

Timing: Vertical rate—60Hz - Horizontal rate—16,200Hz - Crystal—12.44MHz

Interface: Composite video, 75 ohm - Separate video, horizontal vertical sync - Memory mapped board

On-board memory: 1024 bytes - 2102AL-2 (250 nsec) - Dip switch addressing in 1K increments

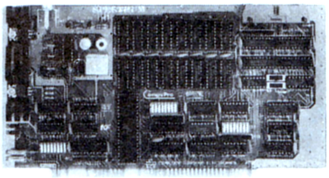
Buffering: All lines buffered

Software: Driver routine for cursor control, scroll up, etc. - Driver routine for X-Y graphic control

		List Price	Our Price
SSMVB1CK	KIT		**$179.00**
SSMVB1CA	Assembled & Tested	$242.00	**$220.00**

CompuPro™ from GODBOUT

SPECTRUM S-100 COLOR GRAPHICS BOARD



The **SPECTRUM COLOR GRAPHICS** Board is actually three products in one: a full-function color graphics generator; a parallel I/O port; and an 8K static RAM board. These three sections work together to create a new standard of flexibility in the generation of color graphics.

ALPHANUMERIC AND GRAPHICS MODES AVAILABLE

MODE	DENSITY	AVAILABLE COLORS	RAM USED
ALPHA	32 x 16	2	512 BYTES
SEMIGRAPH	64 x 32	8	512 BYTES
GRAPHICS	64 x 64	4	1K BYTES
GRAPHICS	128 x 64	2	1K BYTES
GRAPHICS	128 x 64	4	2K BYTES
GRAPHICS	128 x 96	2	1.5K BYTES
GRAPHICS	128 x 96	4	3K BYTES
GRAPHICS	128 x 192	2	3K BYTES
GRAPHICS	128 x 192	4	6K BYTES
GRAPHICS	256 x 192	2	6K BYTES

SPECIFICATIONS

Memory Addressing: 8 K block (switch selectable)

Extended Addressing: Any 64K page (switch selectable; may be defeated).

Port Addressing: Any port pair in the 256 port I/O space (switch selectable); Status/Control Port at switch address. Data Port at switch address + 1.

Wait States: Optional wait state may be inserted in graphics mode.

Video Levels: Standard RS-170 composite NTSC video (Sync#0V, Black = 0.7V, White = 1.5V.

Video Connectors: Standard RCA type female for 75 Ohm coax; four pin male (with power) for standard modulator.

Colors Available: Color Set 1: Green, Yellow, Blue, and Red - Color Set 2: Buff, Cyan, Magenta, and Orange.

Parallel Data Lines: 8 latched input lines (TTL levels) - 8 latched output lines with 24 mA drive (TTL).

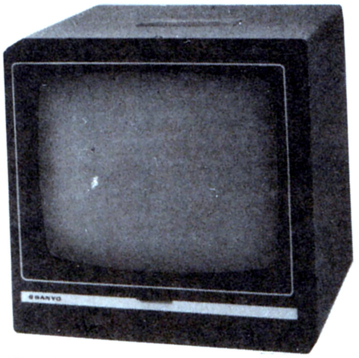
Parallel Control Lines: Strobe, enable, and attention lines with selectable polarity.

Parallel Power Lines: Available power at connector: +5V at 200 MA, +12V at 40 mA, −12V at 40 mA.

		List Price	Our Price
GBT144U	Unkit		**$299.00**
GBT144A	Assembled & Tested	$399.00	**$349.00**
GBT144C	CSC	$449.00	**$399.00**
GBT2D	Sublogic Universal Graphics Interpreter Software		**$35.00**

SANYO

FCC CLASS 2 APPROVED DATA DISPLAY MONITORS



SYOVM4509

DATA DISPLAY 10MHz MONITOR 9 INCH DIAGONAL

List Price: $235.00 **Our Price: $198.00**

Compact, affordably priced data display monitor is ideal for personal use or where space is limited. Features a 44 sq. inch viewing screen; white data display; up-front controls and easy care steel cabinet. Standard EIA timing provides a 16 line x 64 character display format. Requires 1.0 volt p-p composite video input.P4 Shipping Weight 15 lbs.

Horizontal Resolution 700 lines, minimum at center

SYODM5012

HIGH PERFORMANCE DATA DISPLAY 18MHz MONITOR, 12 INCH DIAGONAL

List Price: $340.00 **Our Price: $310.00**

Designed for use with advanced level computer systems. Features an anti-reflective, 75 sq. inch viewing screen; white, high resolution data display; up-front controls and easy care steel cabinet. Computer compatible timing provides a 24 line x 80 character display format. Requires 1.0 volt p-p composite video input.P4 Shipping Wt. 24 lbs.

Horizontal Resolution 800 lines, minimum at center

SYODM5112

PROFESSIONAL GREEN DATA DISPLAY MONITOR 12 INCH DIAGONAL

Shipping Weight 24 lbs.

List Price: $360.00 **Our Price: $325.00**

Same as above except GREEN on Black display. P31

SYOVMC6013

COLOR DATA DISPLAY MONITOR, 13 INCH DIAGONAL

List Price: $550.00 **Our Price: $495.00**

High performance color data display monitor for use with color capable computer systems. Features an in-line gun, slotted black matrix CRT with 90 sq. inch viewing area; up front controls and easy care steel cabinet. Standard EIA timing provides a 16 line x 64 character display format. Requires 1.0 volt p-p composite video input Ship. Wt. 35 lbs.

Horizontal Resolution Color: 270 lines; Monochrome: 350 lines

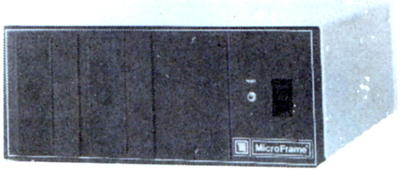
PLEASE ORDER BY PART NUMBER

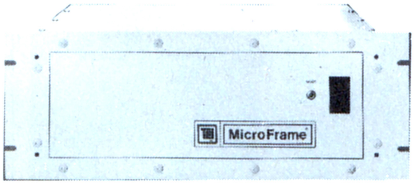
PRIORITY ONE ELECTRONICS

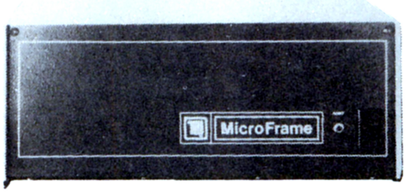
MicroFrame

The S-100 Standard

The Best S-100 Enclosure Money Can Buy







How true. The MicroFrame® is the heart of your computer system. Lots of people have good ideas on mainframe design and technology... **TEI** people make them work. That's how **TEI** has become the industry leader...manufacturing uniquely useable reliable products for over a decade.

From the power supply through the sturdy chassis. **TEI** constructs and assembles each MicroFrame® with great care. Every MicroFrame® utilizes a constant voltage transformer (CVT) which delivers clean, regulated power at the proper level, reducing the heat in the computer cards. The output voltage on the transformer remains nearly even in typical applications with the input voltage varying from approximately 50V to 140V. This means the MicroFrame® will never notice voltage variations or even a brown out. It also provides 100 dB noise rejection to protect the computer from voltage spikes and line noise. No need for a dedicated line or expensive noise filters. **TEI** was the first manufacturer to offer the CVT in it's complete computer product line and is still one of few manufacturers to offer the CVT as standard equipment...people making good ideas work.

BENEFITS OF A CVT

A constant-voltage transformer produces an essentially-constant secondary voltage for a wide range of input voltage and output current variations (Figure 1).

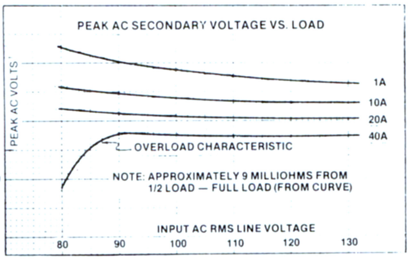


Figure 1 Typical Constant-Voltage Transformer Curves.

Why is this desirable? Because, in real life, line voltage transients frequently exceed 300 volts for relatively long periods, and can reach several thousand volts for short periods. Conventional linear transformers simply offer no protection against these transients, leaving the remainder of the power supply (and all the computer logic fed from that supply) to cope with them as best they can. With a CVT, however, the secondary output remains steady, calm, and unaffected.

As an added benefit, the CVT output waveform (Figure 2, top) has two significant advantages over the sinusoidal output waveform (Figure 2, bottom) of a conventional transformer. First, although the waveform shape may change slightly with changing input voltage and load conditions, the peak voltage is nearly constant. Thus, the DC level after rectification and filtering is more nearly independent of input voltage changes. In fact, CVT regulator is such that a power supply consisting of nothing more than a CVT, rectifiers and filter capacitors can be constructed with the line and load regulation shown in Figure 2.

Secondly, with this waveform, rectifiers conduct over a greater portion of the cycle. This reduces the peak current required to store a given amount of energy in the filter capacitors, that is to say, reduces the ripple current. Since the failure rate for filter capacitors is a function of ripple current, this is highly important to the reliability of the power supply. Simply changing from a linear transformer to a CVT typically reduces ripple current by about 40 per cent.

Consider the design of a 5-volt, 50-ampere power supply with a full-wave rectified series-pass regulator combination to operate from a commercial AC line known to vary from 100 to 130 V. The series-pass regulator requires 8.5 VDC raw input.

With a linear transformer, regulator input voltage varies linearly with line voltage (ignoring rectifier voltage drop which is essentially constant). If regulator input voltage is the required 8.5 VDC at the minimum line voltage (100VAC), then the voltage at this point must rise to 8.5 x (130/100) = 11.05 volts at maximum line voltage (130VAC).

This extra 2.55 volts at the 50-ampere design load requires that the regulator dissipate an extra 127.5 watts of heat. This may require larger heatsinks, more costly pass transistors, extra System cooling — the list goes on and on.

Now consider the design with a CVT. At 100-VAC input, the regulator still receives 8.5 VDC, but at 130 VAC, the CVT property allows the regulator input to rise less than 5%, or about 0.3 VDC. At 50 amps, 0.3 VDC is 15 watts — 8.5 times better than the linear design.

Other benefits occur with the CVT design. **A linear transformer passes the electrical "garbage" on the power-line straight through to the regulator.** And what happens there? Thermally-stressed power semiconductors continually submitted to these transients are strong candidates for early failure. Since **the CVT does not pass transients,** power semiconductors live on, and on.

A linear transformer also passes noise. Since the regulator has only a finite ability to reject noise (noise in = noise out, to paraphrase a popular computer saying), anything that reduces noise ahead of the regulator, reduces noise at the output.

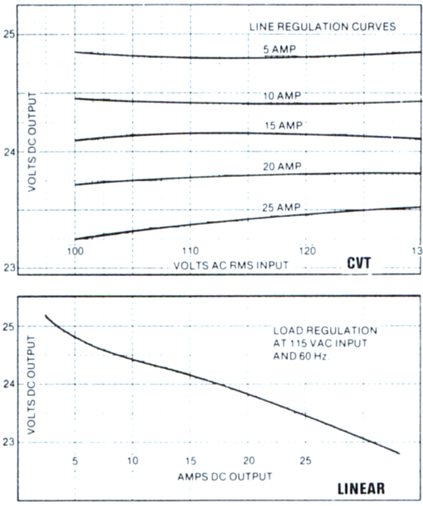


Figure 2 Typical Line and Load Regulation for CVT-Based Power Supply Without Electronic Regulation.

BENEFITS FROM HIGH POWER SWITCHING REGULATORS

A single constant-voltage transformer/rectifier combination to supply the highest required voltage, then high efficiency switching-type voltage regulators to furnish the lower voltages. Recent improvements in semiconductors have made this approach quite feasible.

As the power source for a switching regulator, two CVT properties enable regulator efficiencies as high as 92% — a figure not reachable with standard devices.

First, since the AC input to the rectifier is fairly constant over a wide range of input voltages, the DC input to the regulator is fairly constant. In most cases, this allows use of semiconductor devices with lower peak voltage ratings. Secondly, since the CVT rejects transients, switching components are not subjected to voltage spikes that can "punch through" junctions and destroy devices.

CONSTANT VOLTAGE TRANSFORMER CONSTRUCTION

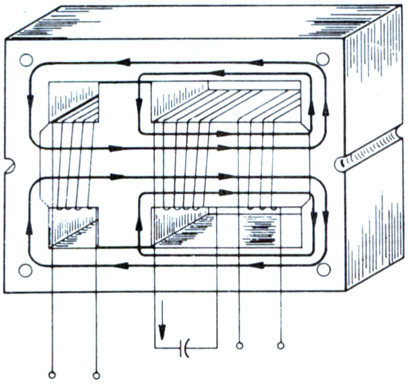


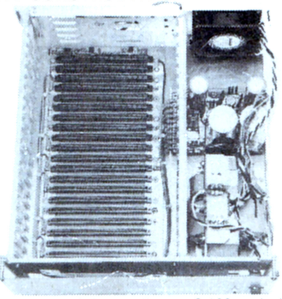
Figure 3 Constant-Voltage Transformer Construction.

The separate box frame and cruciform core allows operation of primary and secondary windings at different flux levels and reduces leakage currents — an important consideration in medical instrumentation, for example. The capacitor winding allows use of a smaller value at a higher voltage.

SUMMARY OF CVT BENEFITS

The constant-voltage transformer offers significant advantages in computer power supplies: high efficiency, super regulation, low noise, long component life, high reliability. That is why **TEI. Inc.** — for over a decade a manufacturer of high quality CVT-based power supplies — insists on CVT power supplies in its Mainframes and Computer systems. And that's why we think you should insist on **TEI., INC.** CVT-based power supplies, too.

QUALITY CONSTRUCTION



The TEI MicroFrame® Series offers an S-100 motherboard which is grounded, shielded and actively terminated for high speed (10MHz) operation now or later upgrading. The enclosure is stamped from 060 and 090 heavy gauge sheet metal at TEI's Houston facility. To meet TEI's high quality standards, each major MicroFrame® component is assembled at TEI. Not only does TEI wind their own transformers, build their own motherboard, and stamp their own sheet metal, then even paint their own wire for the power supply. Quality from the bottom up to protect your computer investment. Each MicroFrame® is shipped completely assembled, tested and burned in, with fan, washable filter, all connectors and card guides. Rackmount models are available in both 12 and 22 slot MicroFrames®.

		LIST PRICE	OUR PRICE	
PART NO.			**1-9**	**10-24**
TEIMCS 112	12 Slot Desk	$685.00	**$615.00**	**$570.00**
TEIMCS 122	22 Slot Desk	$825.00	**$760.00**	**$705.00**
TEIRM 12	12 Slot Rackmount	$725.00	**$720.00**	**$619.00**
TEIRM 22	22 Slot Rackmount	$875.00	**$850.00**	**$750.00**

Shipping Weight: On 12 Slot Mainframes 45 lbs.
On 22 Slot Mainframes 55 lbs.

12 Slot: +8V 17A ±16V @ 2A
22 Slot: +8V @ 30A ±16V @ 4A

S-100 MAINFRAME WITH 12 SLOT MOTHERBOARD AND CUTOUTS FOR 2 5¼" FLOPPY DISK DRIVES

WITH INTERNAL POWER CABLES

		LIST PRICE	OUR PRICE	
PART NO.	**DESCRIPTION**		**1-9**	**10-24**
TEITF12	12 Slot desk	$675.00	**$625.00**	**$580.00**
TEIRD12	12 Slot rackmount	$795.00	**$715.00**	**$665.00**

Shipping Weight: On 12 Slot Desk 40 lbs.
On 12 Slot Rackmount 45 lbs.

+8V @ 17A ±16V @ 2A +12V @ 1.2A

DUAL 8" DISK DRIVE CHASSIS

For Shugart 800/801R or 850/851R with internal power cables provided.

		LIST PRICE	OUR PRICE	
PART NO.	**DESCRIPTION**		**1-9**	**10-24**
TEIDFDO	Desk Top	$535.00	**$485.00**	**$455.00**
TEIRFDO	Rackmount	$725.00	**$670.00**	**$630.00**

Shipping Weight: Desk Top 40 lbs.
Rackmount 45 lbs.

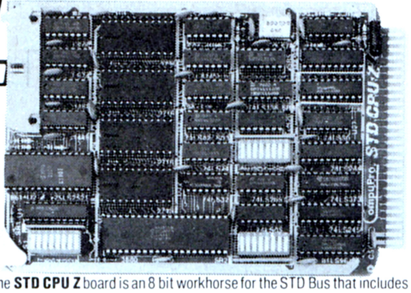
+24V @ 1.5A +5V @ 1.0A - 5V @ .25A

Priority 1 Electronics is a master distributor for TEI. Dealers & OEM's call for quantity pricing.

CALL FOR QUANTITY PRICING

PRIORITY ONE ELECTRONICS

CompuPro™ STD PRODUCTS STD CPU Z PROCESSOR BOARD



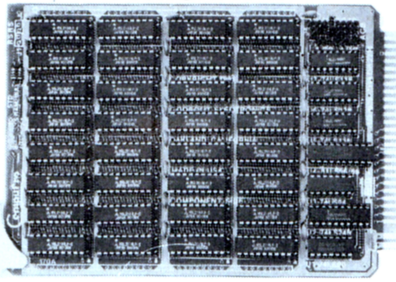
The **STD CPU Z** board is an 8 bit workhorse for the STD Bus that includes all standard Z80A features...and a whole lot more:

- Downward compatible with the vast library of 8080 software.
- Designed for clock speeds up to 6 MHz.
- High operating speed greatly increases system throughput.
- Provision for adding up to 8K bytes of on-board memory (2716 EPROMs, or HITACHI 6116 RAM chips; not included with board).
- On-board memory sockets can be disabled under software control to allow overlapping external RAM.
- Memory addressable on any 8K boundary with DIP switch.
- Memory sockets can be individually disabled.
- Power-on clear generates SYSRESET*.
- Selectable automatic wait state insertion for servicing M1* instructions - MRQ* - I/O RQ* - or the on-board memory (individually or severally selectable).
- Jump on SYSRESET* or power-on to any 256 byte boundary.
- On-board UART for serial communication with terminal or printer.
- Baud rate software selectable up to 19.2 KBaud.
- UART addressable as a 4 port block anywhere in the I/O map.
- Includes all functions necessary for a complete stand-alone computing system (CPU, UART, 8K optional memory).

Now there's a cost-effective alternative to standard STD CPU boards; thanks to the on-board memory sockets and UART, STD CPU Z is a reasonably powerful stand-alone microcomputer that's ideally suited for such applications as industrial control. Running at 4 or 2 MHz (6 or 3 MHz with the CSC board), and fully compatible with the STD bus. STD CPU Z is cost-competitive with other CPU boards thaT DO A WHOLE LOT LESS.

PART NO.	DESCRIPTION	PRICE 1-4	PRICE 5-9
GBT173A	Assembled & Tested, 2/4 MHz.	**$335.00**	**$301.50**
GBT173C	CSC, 3/6 MHz	**$435.00**	**$391.50**

16K STD RAM



STD RAM - 16K from **CompuPro** is the answer for STD Bus applications requiring both versatile, and highly reliable static memory storage. This 16K x 8 memory board consists of two 8K blocks, addressable on any 8K boundary. The board may be optionally populated with the new XICOR 2214 shadow RAM chips, thus enabling the user to have nonvolatile memory. ("Shadow" RAMs use a fast RAM array that overlays non-volatile storage, thereby allowing for fast access along with easy permanent storage/retrieval by a single pulse.) Any number of 1K blocks may be populated with shadow RAMs, making **STD RAM - 16K** ideally suited to industrial control or other applications where non-volatile storage is crucial. This highly cost-effective memory includes the following important features:

- Fully static design for highest reliability and CPU independence.
- Two independently addressable 8K blocks.
- Both blocks can respond to the memory expansion line.
- Fully socketed for easy maintenance.
- Meets all STD Bus timing requirements.
- Accepts shadow RAM chips in 1K increments (simply replace standard 2114 RAM chips with board) for up to 16K of non-volatile storage.
- Fast 300 nanosecond access time.
- Low, power consumption.
- Fully bypassed for trouble-free operation in high-noise environments.

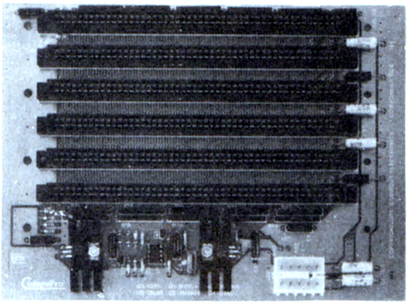
Whether your STD Bus application is for industrial control or systems development, **CompuPro's STD RAM - 16K** delivers low power consumption, high reliability, fully static design, and the option for non-volatile storage using 2214s.

PART NO.	DESCRIPTION	PRICE 1-4	PRICE 5-9
GBT170A	Assembled & Tested	**$325.00**	**$292.50**
GBT170C	CSC 200 Hr. Burn In	**$425.00**	**$382.50**

Order CompuPro Std Motherboards to the right. Order Vector STD boards and card cages on page 33

CompuPro™ from GODBOUT ELECTRONICS

S-100 & STD MOTHERBOARDS



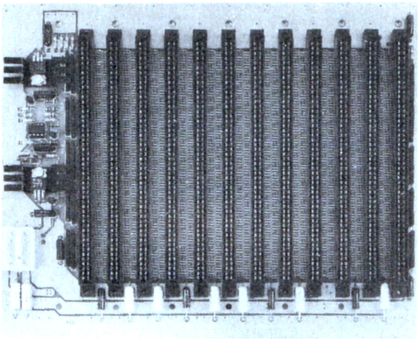
- All motherboards are designed for up to 10 MHz operation.
- S-100 Motherboards are available in 6, 12 and 20 slot versions.
- STD Motherboards are available in 8 and 16 slot versions.
- S-100 Motherboards have IMSAI compatible mounting.
- STD Motherboards fit Vector Electronics' card cages.
- S-100 Motherboards have active termination circuitry on all signal traces.
- Each motherboard has full Faraday shielding between all signal traces (plus additional shielding on the opposite side of the PC board) to minimize noise and crosstalk.
- All motherboards have convenient power connectors.
- Mating power connectors provided.
- All motherboards have connector for adding RESET button.
- All motherboards have capacitor bypassing to ground on all power traces.
- Edge connectors are spaced on 0.75" centers.
- Heavy power traces ensure high reliability.
- Gold-plated edge connectors provided for all slots.
- S-100 20 slotmotherboard has extra fast-on connectors for more efficient +8 volt distribution.

SPECIFICATIONS

IEEE-696/S-100 MOTHERBOARDS:
Number of Slots - 6, 12 and 20 slots available.
Termination - Active termination on all signal lines at both ends of the motherboard.
Mounting - Compatible with IMSAI type chassis and Vector Electronics' card cages.
Front Panel Connector - 20 slot motherboard has first connector offset to accommodate IMSAI front panels.
Dimensions - 6 slot: 6.5 x 9 inches; 12 slot: 11 x 9 inches; 20 slot: 17 x 9 inches.

STD MOTHERBOARDS
Number of Slots - 8 and 16 slots available.
Mounting - Compatible with Vector Electronics' card cages.
Dimensions - 8 slot: 7 x 4.35 inches; 16 slot: 13 x 4.35 inches.

COMMON FEATURES
Shielding Method - Ground shield between every signal trace.
Bypassing - Thorough capacitor bypasing on all power traces.
Power Connection - All DC power connects through convenient PC mount plugs (mating connectors provided).
RESET Connector - Provided.
Edge Connectors - Gold-plated.
Connector Spacing - Centers spaced 0.75 inches.
PC Board - High quality FR4 epoxy glass, solder masked both sides, screened component legend, plated through holes.



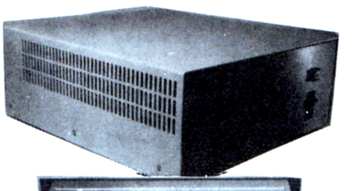
S-100 MOTHERBOARDS

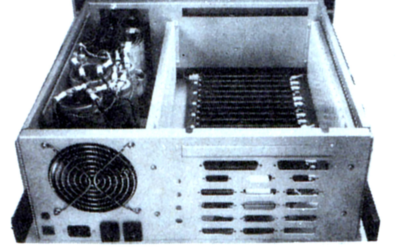
PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
GBT153A	A&T 6 slot, 2 lbs.	$140.00	**$126.00**
GBT153C	CSC 6 slot, 2 lbs.	$190.00	**$175.00**
GBT154A	A&T 12 slot, 2 lbs.	$175.00	**$155.00**
GBT154C	CSC 12 slot, 2 lbs.	$240.00	**$220.00**
GBT155A	A&T 20 slot, 4 lbs.	$265.00	**$235.00**
GBT155C	CSC 20 slot, 4 lbs.	$340.00	**$310.00**

STD MOTHERBOARDS

PART NO.	DESCRIPTION	1-4	5-9
GBT168A	A&T 8 slot, 2 lbs.	**$135.00**	$121.50
GBT169A	A&T 16 slot, 3 lbs.	**$175.00**	$157.00

CompuPro™ from GODBOUT ELECTRONICS





SYSTEM ENCLOSURES

Now . . . a place to put all those CompuPro or other S-100 boards. The enclosures are available in eiher desk top or rack mount (including slides) and both have the following features:

Enclosure

- Quiet fan provides for cool system operation.
- Two switched convenience outlets on the rear.
- Line filter for electrical noise suppression.
- Circuit breaker for safe operation.
- Lighted RESET BUTTON FOR "POWER ON" indication.
- Punchouts on rear for 12 DB-25 connectors.
- Punchouts on rear for 2 DD-50 connectors.
- Positive pressurized for ease of filtration.
- Provisions for mounting a front panel.
- Physically 18.5" deep, 7" high, 17" wide (rack front panel 19" wide).

Motherboard

- Contains **GTB155A** 20 slot motherboard, see complete description at left.

Power Supply

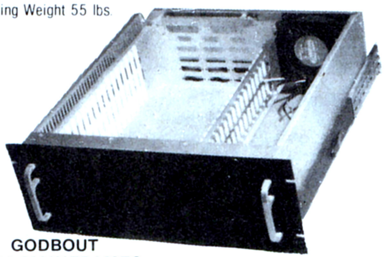
- Twenty-five Amps at 8.0 volts D.C.
- Three Amps each at +16 and −16 volts D.C.
- Outputs vary less than 5% over input range of 100 AC to 130 VAC.
- **Constant voltage transformer.**
- All outputs fused.

With all the features listed above, the individual assembling a system can be sure that he will have the very best foundation possible for an IEEE 696-S-100 system that will give years of reliable service. And because of the constant voltage transformer the power outputs can be kept near the minimum required with no worry about system failure. This allows the system to run cooler, and the regulators to stay cooler also.

The CompuPro enclosure components are available individually, or as a packaged unit, providing the customer with maximum flexibility.

		List Price	Our Price
GBTENC20RM	20 Slot Rack Mount	$895.00	**$825.00**
GBTENC20DK	20 Slot Desk Top	$825.00	**$760.00**

Shipping Weight 55 lbs.

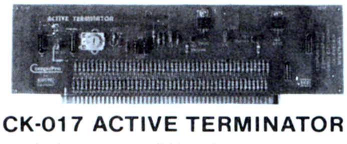


GODBOUT S-100 MAINFRAMES

- Same as above less power supply & motherboards.
- Base is drilled to accept all Vector & Godbout motherboards.

GBTBOX DESK	Desk Top Main Frame	**$289.00**
GBTBOX RACK	Rack Mount Main Frame	**$329.00**

Shipped Unassembled, weight 23 lbs.



CK-017 ACTIVE TERMINATOR

Active termination promotes reliable and accurate data transfer by minimizing the ringing, cross-talk, overshoot, noise and other gremlins that can occur with unterminated lines. Also saves considerable energy compared to passive termination systems, thereby putting less strain on your power supply and keeping heat out of the enclosure. All lines (except power & ground) terminated to 1.7V through 270 ohms.

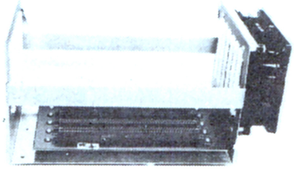
GBT106U	Kit - 1 lb	**$34.95**

CA, AK, HI, CALL (213) 709-5464

PRIORITY ONE ELECTRONICS

QT COMPUTER SYSTEMS

SILENCE + MOTHERBOARDS AND CARD CAGES



QT S-100 CARD CAGES

QT Card Cages are designed for use with Silence + Motherboards. They are perfect for industrial control applications with the addition of a CPU and memory card with the Silence + Motherboard.
Available versions are listed below:

FEATURES:

- Available in 6, 8 or 12 slot Motherboard configurations
- Accepts 4" fan
- Anodized

	6 Slot Card Cage (5¾" x 10-1/8d x 6"h)	
QTCCC6	Card Cage	**$ 24.00**
QTCCC6-1	w/6 slot Motherboard and card guides	**$ 90.00**
QTCCC6-2	w/6 slot Motherboard card guides and fan	**$115.00**
	8 Slot Cage (7¼"w x 10-1/8d x 6"h)	
QTCCC8	Card Cage	**$ 38.00**
QTCCC8-1	w/8 slot Motherboard and card guides	**$100.00**
QTCCC8-2	w/8 slot Motherboard card guides and fan	**$135.00**
	12 Slot Card Cage (11½"w x 10-1/8d x 6"h)	
QTCCC12	Card Cage	**$ 60.00**
QTCCC12-1	w/12 slot Motherboard and card guides	**$115.00**
QTCCC12-2	w/12 slot Motherboard card guides and fan	**$150.00**
QTCCC12-3	w/12 slot Motherboard card guides and 2 fans	**$185.00**

QT SILENCE + MOTHERBOARDS

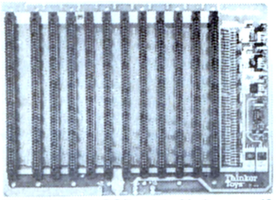
The Silence + has become one of the most tried and proven motherboards on the market. Using a unique grounding matrix, each line is completely surrounded with ground shielding which eliminates necessity for termination and gives the unit a very high cross talk rejection. One of our OEM customers has used the Silence + as high as 14MHz without terminations.

FEATURES:

- LED power indicator
- Eliminates necessity for termination
- Fits most industry standard mainframes
- Available in 6, 8, 12 and 18 slot configurations.

QTCMB6BB	6 Slot Bare Board	**$ 25.00**
QTCMB6K	6 Slot Kit	**$ 40.00**
QTCMB6A	6 Slot A&T	**$ 50.00**
QTCMB8BB	8 Slot Bare Board	**$ 27.00**
QTCMB8K	8 Slot Kit	**$ 55.00**
QTCMB8A	8 Slot A&T	**$ 70.00**
QTCMB12BB	12 Slot Bare Board	**$ 30.00**
QTCMB12K	12 Slot Kit	**$ 70.00**
QTCMB12A	12 Slot A&T	**$ 90.00**
QTCMB18BB	18 Slot Bare Board	**$ 50.00**
QTCMB18K	18 Slot Kit	**$100.00**
QTCMB18A	18 Slot A&T	**$140.00**

MORROW DESIGNS



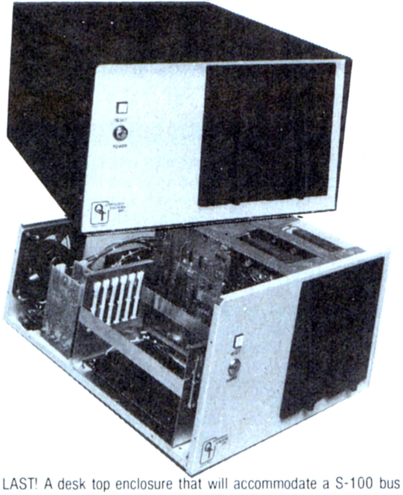
THE WUNDERBUSS™ with Noisegard®
High-performance S-100 bussboards

Edge Connectors: S-100 type, .125" spacing on ¾" centers. **Shielding:** Every signal fully shielded by both interconnected ground lines, 2nd cross-coupled ground planes. **Termination:** Active termination of each line. Termination network includes LM 201 op amp and 2 PNP/NPN pairs for buffering to 2.4 volts at 180 ohms. **Mounting:** Holes at each edge connector position,plus auxiliary holes to fit IMSAI cabinet. **Power Connectors:** "Fast on" connectors at all 10 positions. **Power Required:** 7 to 10 volts; 14 to 20 volts; — 14 to—20 volts. **Peripheral Power Outputs:** 5 vlts at 1 amp, 12 volts at 500ma'—12 volts at 500ma. **Circuit Board:** Double-sided glass epoxy with plated through holes. Solder mask on both sides and part legend.

MDS1200 12 slot, A&T, SH. WT. 2 lbs. **$149.00**

MAINFRAMES

S-100 MAINFRAME FOR DUAL 8" DISK DRIVES



AT LAST! A desk top enclosure that will accommodate a S-100 bus system and two 8" disk drives. The MF+MD mainframe is the most versatile dual 8" mainframe on the market. It will accommodate 6, 8, or 12 slot card cages using the Silence + motherboards. Just add a CPU, memory board, disk controller and terminal and you have an inexpensive, high quality computer system.

FEATURES:

- Accommodates any 8" standard disk drive (801R, DT-8, etc.)
- IEEE S-100 Silence + 6, 8, or 12 slot motherboard available. (See motherboard description at left.)
- Keyed powered switch.
- Reset switch on front panel
- Anodized 6, 8, or 12 slot card cages
- Quiet fan provides cool system operation featuring filtered positive air pressure. User may ad two additional fans for the 12 slot if required.
- Detatchable line cord plugs directly into EMI filter for electrical noise suppression.
- Two AC convenience outlets for accessories
- 16 DB25 cut outs order 24" or longer cables on page 6.
- 2 50 pin plug connector cut outs.
- 2 DD55 cutouts
- Dimensions 9⅝" x 17" x 21" (HxWxD)
- Power Supply +8V@25A/±16V@5A/+5@2.5A/-5@.5A/+24@3A
- Input Voltage 110-113VAC/220-240VAC 50-60Hz 48 lbs.

PART NO.	DESCRIPTION	PRICE
QTCMFDD	without Motherboard	**$575.00**
QTCMFDD6	with 6 Slot Motherboard	**$625.00**
QTCMFDD8	with 8 Slot Motherboard	**$650.00**
QTZMFDD12	with 12 Slot Motherboard	**$700.00**

QT MF+ MAINFRAMES

QT Mainframes are of highest industrial quality construction. By using steel construction, we have developed a compact and sturdy unit for the industrial user. The Motherboard is "The tried and proven" Silence Plus, which uses a unique grounding matrix. Each line is completely surrounded with ground shielding which eliminates the necessity for termination and gives the unit a very high cross talk rejection.

FEATURES:

- Quiet fan providing cool system operation — featuring filtered positive Air pressure.
- Line filter for electrical noise suppression.
- Circuit breaker for safe operation.
- 12 DB25 cutouts
- 2 50 pin plug connector cut outs.
- Card guides installed for number of slots of DD50 MB requested.
- Dimensions 7X17X20" (178x432x508mm) (HxWxD)
- Fused power
- Power supply +8VDC @ 25A ±16VDC @ 5A
- Input voltage 110-130VAC/220 - 240VAC 50—60Hz.
- Power and reset switches located on front panel. 45 lbs.

PART NO.	DESCRIPTION	PRICE
QTCMF	without Motherboard	**$350.00**
QTCMF12	with 12 Slot Motherboard	**$450.00**
QTCMF18	with 18 Slot Motherboard	**$500.00**
QTCMF22	with 22 Slot Motherboard	**$550.00**

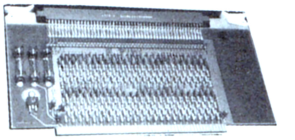
California Computer Systems

2200 MAINFRAME

- 12-slot motherboard with removable termination card.
- "Double-path" trace pattern halves line inductance
- Solder-plated circuit area
- 12 pairs of locking card guides to keep peripheral boards stationary
- Distributed by-passing of all power lines
- Built-in circuit breaker
- Maximum cooling efficiency produced by built-in fan under any load condition in the motherboard
- Flip top cover for easy access to components
- Illuminated reset switch on the front panel
- Required Power: 110 VAC/60 Hz, 220 VAC/50 Hz
- DC Power Available: 20 amps @ + 8VDC
  4 amps @ + 16 VDC
  4 amps @ - 16 VDC

Shipping Weight 35 lbs.

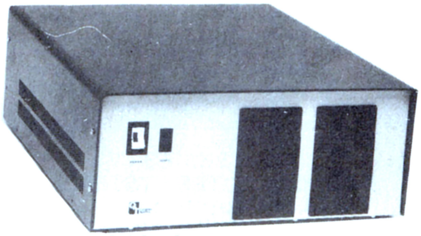
PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS2200-01	Office Cream	$575.00	**$535.00**
CCS2200-02	Blue	$575.00	**$535.00**
CCS2200-03	Cream, 220V, 50Hz	$575.00	**$550.00**



S-100 EXTENDER/TERMINATOR

- Active and/or dynamic termination.
- All power lines fused for protection.
- All S-100 lines labeled and numbered.
- Solder mask both sides of board.
- Silkscreened reference designations.
- Gold plated fingers.

CCS2520 Kit - 1 lb. **$59.50**



(Accepts 2 each 5¼" Disk Drives)

MF + MD MAINFRAME

The MD+MD Mainframe offers the same quality as the MF+. It accepts two 5¼" disk drives with remaining space for either a 6, 8 or 12 slot Silence Plus Motherboard.

FEATURES:

- Quiet fan providing cool system operation featuring filtered positive air pressure.
- Line filter for electrical noise suppression.
- Circuit breaker for safe operation.
- 12 DB25 cutouts
- 2 50 pin plug connector cut outs
- Card guides installed for number of slots of DD50 Motherboard requested.
- Dimensions (7x17x20") (178x432x508mm) (HxWxD).
- Fused power.
- Power supply +8VDC @ 25A ±16VDC @ 5A.
- Input voltage 110-130VAC / 220-240VAC 50-60Hz.
- Power and reset switches located on front panel. 45 lbs.

PART NO.	DESCRIPTION	PRICE
QTCMFMD	with Motherboard	**$400.00**
QTCMFMD6	with 6 Slot Motherboard	**$450.00**
QTCMFMD8	with 8 Slot Motherboard	**$475.00**
QTCMFMD12	with 12 Slot Motherboard	**$500.00**

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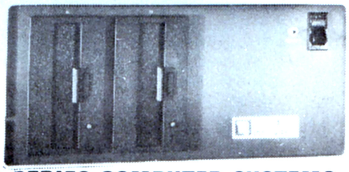
PRIORITY ONE ELECTRONICS

1 ONE

TEI System 3400®



3400 SERIES COMPUTER SYSTEMS
Start With The Best

Until now, choosing the first computer had always been a compromise between what you wanted and what you wanted to pay.

No More! Now you can start with the best! The 3400 Series Computers are fast - 800 nanoseconds instruction cycle (5-MHz)...as fast as midrange minis which allows you to process large jobs.

Large Memory! 64K of 5-MHz memory to take advantage of that speed.

Fast High-Capacity Mini-Floppies! The 3452 system includes 537,600 characters of diskette storage with high speed (6 milliseconds) track to track access.

And reliable! Day in and day out the 3400 Series Computer keeps right on running. Reliability designed in by a company whose reputation for reliability dates over a decade. At TEI, reliability is guaranteed by full-in-house manufacturing. It starts with the basic design, like the constant-voltage transformer that reduces electrical stress on all components. It continues with parts selection, we purchase quality parts and test them for conformity as an on-going process. We design and manufacture all our own PC boards, so we know they are right...and that they will stay right. We test every finished board, heat-cycle it non-stop, then test it again. The 3400 Series Computer with these fully tested boards is then dynamically tested non-stop. Only after passing this exhaustive test is a TEI computer ready for shipment.

SOFTWARE! TEI provides with each 3400 Series Computer system's CP/M compatible T/DOS 2.4 operating system, Super BASIC, ANSI, BASIC and TEI's fast powerful, and flexible database manager Data Magic.

DataMagic System is a comprehensive Database Management System designed for TEI's Business Computer Systems.

The **DataMagic** System is structured around a true multi-keyed indexed-sequential access method (ISAM).

The **DataMagic** Definition Processor (DDP) allows the user to define a database structure that covers any number of diskettes or hard disks attached to the system. A diskette system can be defined for single-density, double-density, or double density/dual-sided drives.

The **DataMagic** Definition Processor allows the user to define up to 250 record structures, all of which contain a primary key and any of which can contain up to 16 alternate keys. Records and alternate keys can be defined at any time.

The **DataMagic** Query Processor (DQP) allows the user to enter data, access data by key, sequentially review data, generate reports, update information within records, delete records, etc. TEI, Inc. provides the Record Access Code Entry (RACE) Program to solve the classic problem of accessinfg the database from an application program.

With the **DataMagic** Definition Processor, **DataMagic** Query Processor, Display Assistance Package, MIRS and RACE, the **DataMagic** System is by far the most comprehensive Database Management System available in the small business computer market today.

INDUSTRY QUALITY ENCLOSURE! The 3400 Series enclosures are built to the same rigid standards that have made the TEI Microframe® an industry standard. The 6 slot motherboard is actively terminated with all bus lines shielded. The heavy-gauge sheet metal housing and constant voltage transformer power supply insure that your TEI system will operate reliably, even in harsh industrial and commercial environments.

3400 SERIES
S-100 COMPUTER SYSTEMS AND PERIPHERALS

3451 Computer System deisgned for single-user business applications. System has an 8085 1.2-MIPS CPU with 64K RAM and I/O 2 board (3 RS232C ports and one parallel printer port,) and FDC-3 controller board. Power supply has high quality constant voltage transformer (CVT) similar to MicroFrame® products. the 3451 includes one single-sided double density 5 ¼" floppy disk-drive.

PART NO.	**List Price**	**Our Price**
TEI3451	$2795.00	**$2520.00**

3452 Computer System is the same as the 3451 except that it includes two double-sided double density 5 ¼" floppy disk drives that will give the user over 500 KBytes of mass storage.

	List Price	**Our Price**
TEI3452	$3295.00	**$2975.00**

3480 Computer System is similar to the 3450 series, except that it has a separate enclosure with 8" single-sided double density drives that give the user over One Megabyte of mass storage.

	List Price	**Our Price**
TEI3480	$4695.00	**$4230.00**

3482 Computer System is the same as the 3480 system except that has double-sided double density drives that give the user over Two Megabytes of mass storage.

List Price Our Price

	List Price	**Our Price**
TEI 3482	$5395.00	**$4860.00**

Priority 1 Electronics is a Master Distributor for TEI. Dealers and OEMs please call for volume quanity pricing.

CompuPro™ division of GODBOUT ELECTRONICS

WHY WAIT ANY LONGER???

SUPERSIXTEEN IS HERE TODAY!!!!
Look What $3495.00 Will Buy!

HERE'S WHAT EACH PACKAGE INCLUDES:

Dual Processor Board. With this high speed board (6MHz operation), you will have the capability to use the vast library of 8 bit software available today, as well as the enhanced 16 bit software being developed at major software houses for tomorrow's demanding applications.

Disk 1 DMA Floppy Disk Controller. This is the product that started the trend to high speed, DMA disk controllers. For maximum flexibility, it handles up to four 8" or 5.25" floppy disk drives, single or double-sided, single or double density (soft sectored).

System Support 1. All the most popular "extras" are on this one board: battery operated clock/calendar; RS-232 serial port; battery backup RAM, math processor, and ROM options; tripple interval timers; dual interrupt controllers; power fail interrupt; and more.

Interfacer 1. Two RS-232 serial ports, with full handshaking and independently selectable Baud rates up to 19.2 KBaud, connect to the serial peripherals (printer, terminal) of your choice.

128K of Static RAM. The best components deserve the best memory, which is why 128K of our famous high speed/low power ram comes standard with every **SuperSixteen** package.

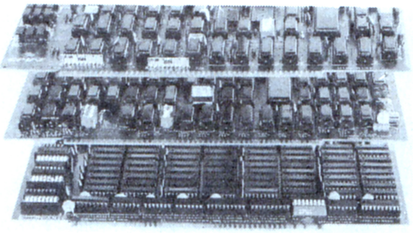
CP/M*-2.2. The most popular 8 bit operating system, ready to load and go.

CP/M* 86 Ready to load and go for 16 bit operation.

Cables and Documentation. Each package includes three interfacer cables, one disk I/O cable, complete documentation for all hardware, and manuals for both CP/M* operating systems.

Now to the best part of all. If purchased separately, these quality components would list for $4,344. **But SuperSixteen's low package price is an amazing $3,495, you save $849.00.** (For boards qualified under: the Certified System Component high-reliability program - with extended 2 year warranty, 200 hour burn-in and 8MHz processors - add $600 to the package price. Standard **SuperSixteen** packages come with usual 1 year limited warranty.) Sh. Wt 15 lbs.

PDBGBTSJ	SuperSixteen A&T	**$3495.00**
PDBGBTSK	SuperSixteen CSC	**$4095.00**



MORE COMPUTING PER DOLLAR THAN EVER BEFORE
"LITTLE 8" SYSTEM STARTER SET

Another **PRIORITY ONE** Exclusive:

Here's what $1095.00 will buy:

CPU Z; A 4MHz Z80A-based 8-bit workhorse CPU board that includes all the standard features plus many of the convenience options. Meets all IEEE 696/S-100 specifications, including timing.

DISK 1 DMA High Performance Disk Controller; disk controllers don't have to be your system's bottleneck! The DISK 1 is lightning fast thanks to properly implemented DMA (with arbitration) and data transfer that is independent of CPU speed.

RAM 20 32K High Speed Static RAM. This board has it all. Operates at speeds up to 10MHz, ultra-low power consumption, IEEE 696/S-100 extended addressing protocol, bank select and flawless DMA.

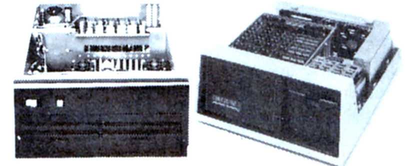
CP/M 2.2; The de facto standard of 8-bit operating systems ready to load and go!

IT ALL ADDS UP TO $1390.00 IF PURCHASED SEPARATELY, BUT YOU WILL SAVE $295.00.

Total Package Price ONLY **$1095.00**

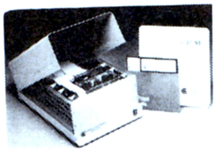
Order Part No. **PDBGBTSG**

MORROW DESIGNS



DECISION 1

Please call for price and configuration information.



California Computer Systems

2210 MICROCOMPUTER SYSTEM

- 2 or 4 MHz operation.
- Z-80 CPU.
- 65,536-C bytes of dynamic RAM
- RS-232-C serial port.
- Accepts 8" and 5¼" floppy disk drives.
- 12-slot cream colored mainframe.
- Internal cabling installed.
- CP/M 2.2 (on diskette) Operating System.

The Model 2210 Computer System is a Z-80 based system containing 65,536 bytes of dynamic RAM memroy and floppy disk controller mounted in a 12 slot mainframe. The system is ideally suited for applications where user defined peripheral devices are to be used and a high degree of system flexibility and expandability is desirable.

The system components are the Models 2810 CPU, 2065 64K Byte Memory Module, 2422 Floppy Disk Controller and 2200 Mainframe. Also included in the system are internal cables interconnecting the CPU serial channel, disk controller 8" disk channel and disk controller 5¼" disk channel to the mainframe back panel. This permits connecting user peripherals directly to the system without the need of opening the mainframe.

Of the 12 slots available in the mainframe, only three are used for the basic system components. 9 slots are available for user options or other CCS products such as memory (expandable up to 512K bytes(, serial and parallel I/O boards.

System software is provided using the CCS version of the CP/M Operating System, Version 2.2. The system is totally linked to permit auto-boot start-up with the CP/M on diskette.

The system is completely integrated and tested prior to shipment to assure proper configuration and system integrity.

PART NO.	**DESCRIPTION**	**LIST PRICE**	**OUR PRICE**
CCS221001	Table Top System	$2350.00	**$1895.00**

VISUAL 200
VIDEO DISPLAY TERMINAL

Looking through the vast selection of products in our Engineering Selection Guide, many people have asked us why we don't have more CRT terminals. The reason is quite simple, until now, we haven't found a terminal that met our high standards of quality and reliability. Over the past few years we have sold or used quite a few different brands of terminals. Half the terminals we received were dead on arrival, on the other half, the keyboard or power supply usually went bad within a few months.

Then, last June, we switched our system over to VISUAL 200 terminals. We were amazed, all of the terminals worked right out of the box. Not one D.O.A.! Now, shifts a day, several months later they are all still working. Finally, a terminal that works! The VISUAL 200 feels like a "real" terminal. The exterior is metal, not plastic. The experienced operator will appreciate the good tactile feel of the Keyboard with 14 user programmable function keys.

Two good examples of thoughtful engineering that went into these terminals is the video output jack for driving a slave monitor and the individual controls for Foreground/Background intensity.

SPECIFICATIONS:

COMMUNICATION: 128 Character ASCII. Serial Asynchronous. 110, 200, 300, 1200, 2400, 4800, 9600, 19200 bps externally switch selectable. **Method** - (Conversational). **Mode** - Full of Half Duplex. **Parity** - Odd, Even, Mark, Space, Switch selectable. **Interface** - EIA RS232C or 20 Ma. Current Loop. 12" non-glare CRT. Composite Video Output for use with external video monitor. **Display Format** - 24 lines X 80 characters. **Character Type** - 7x9 Dot Matrix; 2 dot lower case descender. **Refresh Rate** - 50/60 Hz switch selectable. **Character Set** - 95 ASCII characters; upper/lower case plus 31 characters line drawing set. Detachable solid state typewriter keyboard, Type-o-matic repeat, numeric pad, function keys, caps lock. **DATA ENTRY; Roll Mode** - Bottom line with single line roll up. **Page Mode** - Page overwrite. **TERMINAL FUNCTIONS; Cursor** - Nondestructive block. **Remote Control** - Cursor; Left, Right, Up, Down, Home, Address; Up Scroll. **Functions** - Erase End of Line Page of Field; Clear; Line, or Page. Tab; Back Tab; Insert Character; Delete Character; Set and Reset Columnar Tab; Enable/Disable Hold Screen; Set/Reset Print Copy; Set/Reset Print Only, Print Page; Set/Reset Background; Blink Line; Security Mode; Set/Reset Line Drawing; Read Cursor Address; Read Terminal Status. **PERIPHERAL INTERFACE; Serial Printer** - Rs232C. **INDICATORS; Keyboard** - Caps Lock, Line/Local. **Power** - 50/60 Hz. 110/220 VAC ±15%. 110 watts. **Physical** - Height - 13", Width - 17", Depth - 21", 50 pounds. **Diagnostics** - Memory Self Test on Power Up.

VSL200 **$995.00**

ADDS VIEWPOINT - Detachable Keyboard Serial RS232C. Aux. port. 80x24 display tiltable screen. 40 lbs.

ADDVWPR **$649.00**

WE ACCEPT VISA, and MASTER CARD

PRIORITY ONE ELECTRONICS

SOFTWARE

***ATTENTION SYSTEMS PURCHASERS:** You may save an additional 10%* on your software purchases when you simultaneously purchase any of the systems on the facing page or $2,500 of S-100 Board level products and or peripherals.*

**Valid for prepaid or credit card orders only, sorry no open account orders.*

PRIORITY 1 is pleased to offer the finest in industry standard software. All software is supplied on 8" Single Density IBM 3740 CP/M® compatible diskettes. All software is sold "AS IS" and is non-returnable. If you have questions about the software for your application, order the manual first. Some software is also available for the 5¼" TEI and Micropolis formats, please call.

CCS803 CP/M Version 2.2 Microcomputer Control Program	**$150.00**
CCS2301 MAC-CP/M Macro Assembler	**$90.00**
CCS2401 SID-CP/M Symbolic Instruction Debugger	**$75.00**
CCS2501 TEX-CP/M Text Formatter	**$75.00**
CCS2601 DESPOOL—CP/M Background Print Utility	**$50.00**

CP/M, MAC, SID, TEX and DESPOOL are registered trademarks of Digital Research

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS2101*	Diagnostics	$120.00	**$110.00**
CCS2101M	Manual		**$ 35.00**
CCS201	RM/Cobol	$800.00	**$750.00**
CCS201M	Manual		**$ 65.00**
CCS101	Fortran W/Coupler (ANSI 66, accepts IBM Code)	$350.00	**$325.00**
CCS101M	Manual		**$ 40.00**

CBASIC-2 COMPILER/INTERPRETER

CBASIC-2 is a comprehensive compiler/interpreter for use with the CP/M operating system. One of the many features that makes it particularly suited to business application programs is its speed — it runs five times faster than the original CBASIC1. Also, it has a powerful and comprehensive print-using and formatting capability.

CBASIC-2 was created by Compiler Systems, Inc., formerly Software Systems, the people who created CBASIC-1. CBASIC-2 retains the extended features included in CBASIC-1, including IF, THEN, ELSE and WHILE constructs and access to disk files. It also allows the use of 31 character variable names and the free use of comments, spaces, and tabs. These aid in creating programs that are self documenting and maintainable.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS401	C-BASIC-2	$150.00	**$139.00**
CCS401M	Manual		**$ 32.00**

FMS-80 DATA BASE MANAGER

Much more than just a Data Management System, FMS-80 is the first complete **Management** system for CP/M,* MP/M* or CDOS.** Completely, **menu** driven using a set of interactive integrated component programs, it allows even a novice user to perform complex DBMS functions without writing any programs.

FMS-80 leads you interactively through its file definition process, making additions, deletions and corrections and generating reports from your data files. FMS-80 will help you define selection criteria, to extract information for your reports by upper and lower limits, specific values for fields, etc.

Example: All employees between the ages of 40 and 50 who received an annual salary greater than $20,000. With FMS-80, even complex logical groupings of selection criteria are easily defined and applied. Reports and printed summaries are easy to produce.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS1101	FMS-80 by Systems Plus	$995.00	**$895.00**
CCS1101M	Manual		**$ 70.00**

ACCOUNTING PLUS BUSINESS PACKAGE BY SYSTEM PLUS

FEATURES:

• Fully Interactive 7 Modules • Complete Audit Trail • System Prompted Data Entry • On Line Updating of Data Files • Modules can be purchased as subsets to fit your application • Double Entry Accounting • Error Checking on Data Entry • Maintains open item accounts receivable and accounts payable • Fully Menu Driven • Supports 5 Preprinted Forms: Sales Orders, Invoices, Statements, Purchase Orders, Checks. • CP/M* MP/M* and CDOS** compatible.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS1201		$4950.00	**$3450.00**
CCS1201M	Manual		**$ 70.00**

GRAHAM-DORIAN ACCOUNTING SYSTEM

The complete Graham-Dorian Accounting System consists of seven interactive application packages that can be used on a stand-alone basis or selectively merged to form various complete business systems. In many cases, an application can be added in to another existing application without disrupting the normal routine.

GENERAL SYSTEM DESCRIPTION

The Graham-Dorian Accounting System is an approach to business applications using a data base concept. This system is an on-line transaction-oriented system.

An example of on-line interactivity:

When general ledger and accounts payable are running interactively, an entry to the payables is automatic posted to the ledger: thus the ledger is always current.

Simple to Use:

Ease of operation is a key feature of the system. All information is in question-and-answer form, and fully documented for the user. The operator simply responds in plain English to questions appearing on the screen. All programs are menu driven, and extensive use of the parameterization makes initial set-up easy. An initial program allows the user to set up the entire application to his or her specifications.

Other features of the accounting system:

- Easy closing—no lengthy month-end procedures.
- Source code is included for easy user modification.
- Structure and coding of programs are uniform so that if one application is modified, another may be easily modified to interact.

GENERAL LEDGER

The Graham-Dorian general ledger package is part of the complete system of business application packages that are interactive or will stand alone. A single entry will automatically update and post to the general ledger form the accounts payable and/or accounts receivable packages.

Capabilities Include- Account look-up and change with detail for current and previous month. Chart of accounts (user defined). Recording journal entries (paper audit trail). Transaction register. Trial balance. Financial statements. Monthly closing. Fiscal year closing. Built-in back-up procedure. Keeping 14 months; history.

Powerful: One 8" single-density disk will accommodate data storage for 200 accounts and 2500 transactions.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS1301	General Ledger	$820.00	**$750.00**
CCS1301M	Manual		**$ 50.00**

ACCOUNTS PAYABLE

The Graham-Dorian accounts payable package is part of the complete system of Graham-Dorian accounting packages. It will stand alone or tie to the general ledger package. An entry to the accounts payable will automatically update the general ledger package.

Capabilities Include: Vendor look-up and change, with complete account detail Vendor list. Entering vendor invoices. Writing checks (many options available). Aged accounts payable report—cash flow analysis. Accounts payable check register. Built-in back-up procedure.

Accuracy is assured: All responses are verified before they are entered to the files. Paper audit trails are available where applicable. Complete transaction detail is available for current and previous period.

Flexible: Invoices can be spread to multiple general ledger accounts. Allows for flexible cash flow analysis for four different user-defined periods. Allows for flexible check writing—a check can be written to a specific vendor for specified invoices can partial pay a specified amount and discounts can be taken. Can pay all vendors for all invoices due between any two dates. Can except vendors from that list that you don't want to pay. Flexible recording of vendor invoices can specify discounts by percentages and dollar amounts, due dates, etc.

Powerful: One 8" single-density disk will accommodata data storage for 300 vendors and 1000 open invoices.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS1401	Accounts Payable	$820.00	**$750.00**
CCS1401M	Manual		**$ 50.00**

ACCOUNTS RECEIVABLE

The Graham-Dorian accounts receivable package, part of the complete system of Graham-Dorian accounting packages. It will stand alone or tie to the general ledger package. An entry to the accounts receivable package will automatically update the general ledger package.

Capabilities Include: Customer look-up and change, with complete account detail. Master accounts receivable customer list. Entering customer invoices. Entering payments to invoices (many options available). Printing of statements. Aged accounts receivable report. Built-in back-up procedure.

Accuracy is assured: All responses are verified before they are entered to the files. Paper audit trails are available where applicable. Complete transaction detail is available for current and previous period.

Flexible: Open invoice system with flexible payment posting complete information on invoices, both past and present. Retains information on when invoice was paid. Will tell user date of last payment, amount paid, etc. Invoices may be spread to multiple general ledger accounts. Credit memos may be applied to invoices. Automatically reports aging of accounts in up to four user-defined periods. Flexible payment posting will allow for invoices to be written off in full or in part. Cash may be applied to oldest invoices automatically, if desired, giving the user one of the major advantages of a "balance forward" system.

Powerful: One 8" single-density disk will accommodate data storage for 300 customers and 1000 open invoices.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS1501	Accounts Receivable	$820.00	**$750.00**
CCS151M	Manual		**$ 50.00**

INVENTORY II

Inventory II is designed as a complete inventory control system for the distributor/wholesaler or manufacturer. The system will stand alone or interface with the sales order entry/invoicing package. When interfaced with order entry/invoicing, a complete system can be developed for manufacturers or distributors that will tie into accounts receivable and general ledger. For manufacturing systems, Graham-Dorian's bill of materials (parts explosion) package should be added as an option to inventory II. When inventory is used with order entry/invoicing, an entry to order entry automatically will make adjustments to the inventory.

Capabilities Include: Enter look-up and change a part, with detail of activity. Printing inventory reports. Printing list for physical inventory. Enter purchase orders. Enter receipts, withdrawls, or physical inventory. Built-in back-up procedure.

Inventory reports available: Master list, On order report, Status report, Stock Out report, Reorder report, Sales report, and Physical inventory report, with inventory list in location sequence.

Flexible: Receipts or withdrawls may be entered directly to update quantity on hand. With order entry/invoicing, when an order is generated, the inventory automatically reserves parts. With order entry/invoicing, quantity on hand automatically is updated when orders are shipped. When a purchase order is generated, the user may enter quanity ordered to keep track of the quantity on order for each part.

Powerful: One 8" single-density disk will accommodate data storage for 400 to 500 inventory items.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS1701	Inventory II	$555.00	**$495.00**
CCS1701M	Manual		**$ 50.00**

JOB COSTING

The job costing package is an application originally designed for the general contractor to run interactively with the Graham-Dorian accounting packages or stand alone. Because of the flexibility of the system, however, this package may be useful in a wide variety of applications. Since the user can enter and define his or her own cost codes and jobs, this package can be used as a general job cost or cost accounting system in many businesses.

Capabilities Include: New job set-up. Job look-up and change, with complet job detail available. Job last report. Entry of job cost transactions. Cost code entry, look-up and change. Job cost reports. Actual versus estimated cost per job. Built-in back-up procedure.

Job Cost Report Shows:

Detail expenses by job phase, cost code, and category. Actual expense versus estimated expense for any cost code phase or job. Total job cost for each job.

Flexible: Jobs, phases, cost codes, and categories may be specified or defined by the user. Up to 10 category subtotals ,may be defined by the user and are printed on a separate report for each job. Complete detail may appear for each cost code or the user may opt to bring balances forward for any code, whenever desired.

Powerful: One 8" single-density disk will accommodate data storage for 200 jobs and 3000 cost details.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS20001	Job Costing	$820.00	**$750.00**
CCS2001M	Manual		**$ 50.00**

PAYROLL II

Allows Payroll Verification. Payroll calculations can be verified quickly. User may correct payroll data prior to the checks being typed.

Computes Payroll Information. Figures FICA, federal and state withholding tax. All state tax routines available. Figures payroll tax deposit. Manages medical and miscellaneous deductions. Computes payroll for salaried and hourly employees. Computes overtime. Program allows for special payroll adjustments.

Types Payroll Checks and Maintains Information on Checks. Types out the numerical text as well as the numerical value on checks. Types checks to one or all employees.

Allows For Special Checks. Will allow add-on for bonus or extra pay (with deductions). Handles special amount checks.

Maintains Master File on all Employees. Allows for entry of new employee information. Allows corrections and changes to existing information. Maintains information on terminated employees. Moves terminated employees to a separate storage file.

Lists Information on Checks Written. Lists checks by number or date written. Lists all check stub information. Gives total payroll and breakout for up to six divisions after check listing.

One 8" single-density disk will accommodate dats storage for 100 employees.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCSI601*	Payroll II	$555.00	**$495.00**
CCSI601M	Manual		**$ 50.00**

ORDER ENTRY/INVOICE

The Order Entry/Invoice program is designed for manufacturers, wholesalers or distributors, although it is flexible enough for some retail applications, too. By its very nature, it will almost always be used with an inventory program as part of a complete business system. The Order Entry/Invoice program will run inter-actively with the Graham-Dorian Inventory II. It will automatically post to Acounts Receivable if used, it will also prepare data for entry into the General Ledger.

Capabilities Include: Order Entry, look-up, change, and invoice. Print picking lists, invoices, and invoice register. Built-in back-up procedure.

Flexible: If used with Inventory II, Order Entry will put items on reserve, remove items when shipped. It can specify a ship date, check to see if shipped as originally entered, and then allow for last-minute changes before shipping. Will allow for non-inventory or miscellaneous items. Packing list includes information on the item location and may be used as a packing slip. Invoices may be printed individually or in batches. Orders may be flagged to show it already sent and duplicate invoices may be printed. Invoice register will give either a complete report or a summary. Inventory register will prepare information to take the General Ledger.

Powerful: One 8" single density disk will accommodate dats storage for 200 orders and 1000 line entries.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS2701	Order Entry/Invoice	$820.00	**$750.00**
CCS2701M	Manual		**$ 50.00**

MEDICAL & DENTAL PRACTICE PATIENT BILLING

Both systems are designed to be comprehensive packages for processing financial data for a physician or dentist, whether in general practice or a specialty. Both sets of programs are parameterized for easy installation and use.

Both packages are written in CBASIC-2. The programs allow the user to maintain patient records of charges, payments and insurance information. The dental program prints standard forms of the ADA. Both packages also generate reports of delinquent accounts, daily and monthly transactions.

PROGRAMS:

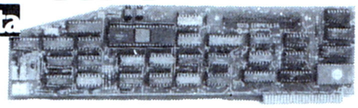
• Create Data Files • Patient Master File Maintenance • Procedure Code Maintenance (Dental) • CPT and ICDA Code Maintenance (Medical) • Enter Treatment/Payment Records • Edit Treatment/Payment Records • Post Payment on Account • Responsible Party Maintenance • Prints Standardized Forms • Statistics • Rebuild Patient Links • Rebuild Charge Links • Rebuild Third Party Links • Create Screen Mask for User Terminal (CRT) • Miscellaneous Functions.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
	Medical Practice Patient Billing		
CCS1801*	15 Programs	$820.00	**$750.00**
CCS1801M	Manual		**$ 50.00**
	Dental Practice Patient Billing		
CCS1901*	14 Programs	$820.00	**$750.00**
CCS1801M	Manual		**$ 50.00**

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

APPLE



A800 DOUBLE DENSITY 8" DISK CONTROLLER

Vista introduces high-speed, DMA data transfer, and high-capacity IBM compatible single and double-density data storage to the Apple II® computer with the A800 Eight-Inch Floppy Disk Controller.

Utilizing state-of-the-art LSI technology, the A800 Controller enables Apple II users to access up to five megabytes of on-line storage through conventional disk operating system commands.

The innovative, proprietary design of the A800 provides phase-locked loop for precise data separation in single (FM) and double (MFM) density modes. Crystal controlled write circuitry, sophisticated direct memory access and data transfer electronics, and complete on-board PROM support routines all surround the most advanced floppy disk control logic unit currently on the market.

Conventional disk access commands under all three major operating systems (Apple DOS 3.2/3.3, Apple UCSD Pascal 1.1, and Microsoft CP/M 2.2) are maintained when accessing the A800 Controller. This provides for complete compatibility with most existing software.

The controller's on-board support PROM allows the eight-inch 3.2/3.3 DOS's to continue complete five-inch support without increasing the operating systems' memory usage. In addition, the eight-inch versions of Apple DOS give the user the ability to create files which occupy up to a full one-megabyte space on a standard double-side, double-density diskette.

FEATURES:

- High Speed DMA Transfer of Data (1 Microsecond/Byte).
- Complete Documentation Provided—Includes Theory of Operation, Source Code for DOS Enhancement Utilities, Schematics and Diskette.
- Uses All Standard Apple DOS Commands (OPEN CATALOG, LOCK, DELETE, LOAD...etc.) Except for INIT Which Has Been Improved and Enhanced in a Vista Format Routine.
- Compatible With Apple DOS 3.2/3.3, Pascal 1.1 and CPM 2.2 (With the Z80 Soft Card by Microsoft)
- Interfaces to All Shugart/ANSI Standard Eight-Inch Floppy Disk Drives.
- 2Kx8 PROM Contains Autoboot Functions and All Eight-Inch Floppy Driver Code Allowing Complete Memory UsageMap Compatibility with Apple DOS 3.2/3.3
- 120 Days Parts and Labor Warranty.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
VISA800	Controller and disk	$595.00	$559.00
VISA800	When purchased simultaneously with one of the "PDB" Vista and TEI disk specials on page 9		$525.00

VISTA APPLE II 5¼" DISK ADD-ONS

The Vista A40, A80 and A160 drives bring new life to the undernourished Apple II® mini-floppy market. Long restricted to a mere 143 kilobytes, Apple II users can now expand their horizons far beyond half a megabyte per drive. Completely compatible with all Apple diskettes, the A40 drive from Vista increases ther maximum storage capacity per drive by more than 13%.

The AA80 and A160, drives for the serious disk user, provide an increase of over 126% and 350% of directly accessible, on-line storage; ideal for most businesses requiring manipulation of large data bases.

In addition to double the storage capacity, Vista offers twice the speed. Access time for the A40 is twice as fast when compared to the Apple Disk II. The A80 and A160, which can access two and four times the data, can reach any point on a diskette in the same time as a Disk II.

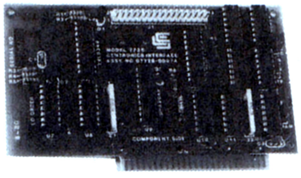
Although all of Vista's Apple II drives are capable of booting and reading any diskette written by a Disk II, Vista supplies a special high capacity version of Apple's 3.2 or 3.3 DOS which is designed to make full use of the advanced features of the A-drive series. This high capacity DOS retains complete compatibility with all existing software which makes the transition from a Disk II to Vista'a Apple II drives fast and efficient.

FEATURES:

- Capacities from 163K Bytes to Over Half a Megabyte Per Drive.
- DOS Configuration Utility Allows Mixing of Different Capacity Drives on the Same System.
- Lowest Cost Per Byte Storage of Any Minifloppy for the Apple Computer.
- Powered Directly from the Apple II Computer.
- Deluxe, Industrial Quality, Color-Coordinated Cabinet.
- High Speed, Metal Band Positioner Accesses Data Twice as Fast as the Apple Disk II.
- Diskette Ejector Mechanism Provides a Human Convenience Factor Normally Found Only on 8" Floppy Disks.
- Completely Compatible with Apple's Disk Controller. Vista Drives May be Used to Enhance an Existing One-Drive Apple Disk System.
- 120 Days Warranty.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
VISA40	40 track, 163K Bytes	$395.00	$375.00
VISA80	80 track 326K Bytes	$595.00	$560.00
VISA160	160 track, 652K Bytes	$895.00	$840.00

PERIPHERALS



California Computer Systems

7710A Asynchronous RS-232C DCE Interface: With cable software.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS771001		$179.00	$139.00

7710D Asynchronous Communications Interface: (Lets the Apple communicate as a remote terminal).

PART NO.	DRESCRIPTION	LIST PRICE	OUR PRICE
CCS771002		$179.00	$139.00
CCS7610A	Firmware ROM General Purpose		$ 24.95

7712 Synchronous RS-232-C DTE Interface.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS771201		$199.00	$159.95

7720 Parallel Interface: Two bi-directional 8-bit parallel data interfaces with handshake lines—optional Centronics firmware version.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS772001	Standard firmware	$145.00	$107.95
CCS772002	Centronics firmware	$145.00	$107.95

7728 Centronics Printer Interface: High speed communcations with devices employing the standard Centronics-type interface.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS7728001		$145.00	$107.95
CCS7340A	Cable for the Integral IDS-440 Paper Tiger		$ 39.95
CCS7379A	Cable for Centronics prin- the Okidata Microline 80. or the Microtek MT-88T		$ 31.95
CCS7388A	Cable for the MPI 88T		$ 29.95

7424 Calendar/Clock: Time of day, month, or year! Your Apple can respond according to timed, programmed instructions. Three operation modes.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS74201		$119.95	$105.00

7440 Programmable Interval Timer. Times intervals in four useful modes.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS74401		$119.95	$103.95

7470 A/D Converter: You can use the Apple as a digital voltmeter to monitor analog voltages. Very flexible.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CSS747001		$119.95	$ 99.95

7811 Arithmetic Processor: Speeds execution of math-intensive programs dramatically. Apple® compatible with additional functions.

781101 Arithmetic Processor: CCSoft diskette (for use with Apple II computers with disk drive-loads in user RAM) (13 sector diskette).

781102 Arithmetic Processor: CCSoft ROM (for use with Apple II with Applesoft or Apple II Plus).

781103 Arithmetic Processor: With CCSoft diskette (for use with Apple II computers with a language card and disk drive) 16 sector diskette).

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS7811*	(01,02,03 ABOVE)	$449.00	$359.95

7490GP1 IEEE 488 Interface: Lets the Apple communicate with instruments over the standard instrument communications bus—full handshaking with up to fifteen interconnected devices.

These three provide handshaking lines and DMA daisy chain support for flexible, useful peripheral communications with a variety of devices.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS749001		$300.00	

7114 12K ROM/PROM. You can modify the firmware of the Apple II® without removing the Apple ROMs. Enabled by toggle, software, or reset.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS7114		$ 99.95	$ 89.95

APPLE II® EXTENDER BOARD

A handy tool when debugging or testing modules in the APPLE II® computer.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
CCS7520A	Assembled		30.00
CCS7001ARAM	(for ROM replacement)		$19.95
CCS7601ROM	(unburned emply)		$19.95

TYPE AHEAD/BUFFER

Up to 40 Character Type-Ahead capability. Enter commands or data while your Apple® is processed previous instructions. Compatible with all Apple® Computers, Keyboards and Software. Includes complete instructions for quick and easy installation. No cuts - No Jumper - No Software patches required. Assembled and Tested.

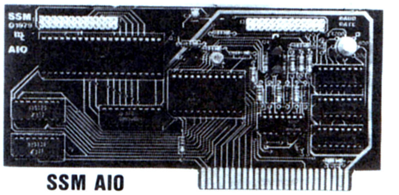
VIS150 $49.95

VISTA MUSIC MACHINE 9

The Vista Music Machine 9 is just the card needed to convert an Apple II® microcomputer into an entire orchestra. A total complement of nine voices makes the Music Machine 9 perfect for keyboard composers everywhere.

VIS0199 $129.00

SSM



SSM AIO

The A10 Apple Interface will allow the user to connect an external parallel or serial driven device, like a terminal or printer, to the Apple II computer. The A10 uses two software controllable LSI (Large Scale Integration) chips for the parallel and serial interfaces to give the user maximum flexibility in configuring to system needs.

- Serial Interface.
- Clear to Send and Request to Send Handshaking.
- 110 - 19,200 Baud.
- 7 or 8 data bits.
- Optional parity, even or odd.
- 1 or 2 stop bits.
- ÷ 1, ÷ 16 or ²÷ 64 clock rate selection.
- Parallel Interface.
- Two 8 bit I/O ports.
- Data lines can be individually controlled for data flow.
- Four handshaking and interrupt control line.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
SSMAIOK	Kit	$160.00	$150.00
SSMAIOA	Assembled & Tested	$195.00	$169.95

SERIAL ASIO™

The ASIO give you a full-duplex RS-232 interface. Plus jumper-selectable rates from 110 to 9600 baud. You also get software control, three handshaking lines and two output plugs—so you can connect your Apple to a modem or to a terminal/printer without changing the cables.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
SSMASIOA	A&T	$139.95	$119.95

PARALLEL APIO™

For parallel interfaces, the APIO offers two 8-bit bidirectional ports. SSM also includes additional interrupt and handshaking lines, plus software control of the interface configuration and data direction.

part no.	DISCRIPTION	list PRICE	our PRICE
SSMAPIOA	A&T	$109.00	$ 95.00

IEEE-488 CONTROLLER

Converts the Apple II, Apple II Plus, into a truly sophisticated controller to interconnect together on the bus.

Make programming easy. The 68488 chip, designed by Motorola, is the heart of the A488 board. This IC puts board's hardware and firmware to work with simple string commands. The only software you need is the easy-to-program Applesoft Basic™. For special purpose firmware development. The PROM is easily repleaceable with a RAM. And bus communications work at top speed, without depending on software loops for timing.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
SSMA488A	Assembled & Tested	$475.00	$399.00

See Page 11 of "Byte" for SSM Information.

APPLE II MODEM ASYNCHRONOUS SERIAL INTERFACE

The new CAT for Apple by Novation is a complete data communications system for the Apple II computer. It consists of a single card LSI modem that offers automatic dialing, answer and disconnect functions plus fully selectable operation from 110 to 1200 baud including the BAUDOT code for the Deaf Network.

300/1200 Baud, LSI Dual Speed. Direct connect Modem with receiver sensitivity greater than—40dBM.

- Auto answer/auto pulse 7 touch tone dialing/auto disconnect.
- Single Unit card with pluggable firmware.
- Software selectable communication speeds compatible with Bell 103 (300 Baud) or Bell 202 (1200 Baud).
- FCC approved for direct connect to phone network-no external coupler required.
- Full/Half duplex at 300 Baud or Half duplex at 1200 Baud.
- Modem plugs into Apple Bus (No external units).
- Easy to use operating programs supplied on Disc.
- Separate RS232 3-wire port for operating Printer/Terminal at 110 to 1200 Baud.
- Power supplied to Apple (minimum load).
- Optional handset provides full telephone capability.
- Optional program ROM's for pascal and CPM.
- Optional Tape input for recording incoming voice messages.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
NOVAPLCAT		$389.00	$359.00
NOV490403	Expansion Module		$ 39.00
NOV490404	*Handset		$ 29.00
NOV490405	BSR Control		$ 19.00
NOV490406	Cassette Rec. Cable		$ 5.00
NOV490497	Touch Tone Receiver		$ 99.00
NOV490408	Firmware		$ 29.00
NOV490409	Deaf Firmware		$ 29.00
NOV490410	Software Diskette		$ 29.00

*Requires expansion module.

VISIT OUR RETAIL SHOWROOM

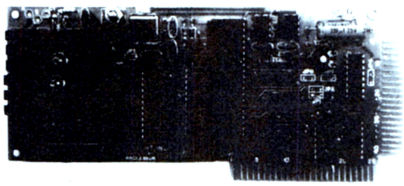
PRIORITY ONE ELECTRONICS

Ciarcia's Circuit Cellar

MICROMOUTH

SPEECH PROCESSOR

AS FEATURED IN JUNE, 1981 BYTE



- 144 expression vocabulary
- Assembled and Tested
- Complete Documentation
- Connect to a speaker or Power Amplifier
- Plugs into Apple II
- Plug compatible with TRS-80 Model 1
- May be adapted to run on the S-100. H-8 or any parallel part

		OUR PRICE
MMI94V0APL	For use with APPLE II. or modified to run with other parallel parts	**$149.00**
MMI94V0TRSI	TRS-80 Model I compatible. complete with interface cable and AC Adapter. less enclosure.	**$169.00**

I/O Interface for TRS-80. Features 50-19200 baud RS-232C Serial port and Centronics printer port. Connect up to 16 COMM-80's to either Keyboard or Expansion Interfacc. Featured in June. 1980 Byte.

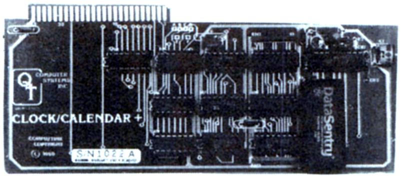
MMICOMM80 . . . . **$179.95**

Expansion Interface for TRS-80 Model 1 with DATA SEPARATOR 32K of RAM and Centronics Printer port. A&T Featured in MARCH. 1981 Byte

MMIDISK80 . . . . **$429.00**

QT COMPUTER SYSTEMS

CLOCK/CALENDARS For the Apple II & TRS-80



These boards have all the same features as the QT s-100 Clock/Calendar on page 3. The QTCCCA is designed to plug into one of the Apple II expansion slots. The QTCCCTRS80 is designed to plug on to one of the TRS-80 expansion ports.

QTCCCABB	Bare Board for Apple II	**$ 60.00**
QTCCCAK	Kit for Apple 00	**$100.00**
QTCCCAA	A&T for Apple II	**$150.00**
QTCCTRS80	A&T for trs-80	**$150.00**

TRS-80 AND APPLE MEMORY EXPANSION KITS

Expand the memory of your computer with 8 factory prime 16K dynamic RAMS. Each kit comes complete with easy to follow step-by-step instructions and a 100% guarantee.

TRS16KEXP This kit allows you to expand from 16K to 32K or from 32K to 48K in your Expansion Interface **$20.00**

TRS16KEY This kit includes the programming jumpers necessary to expand from 4K to 16K in your TRS-80* Keyboard **$23.00**

APL16K Each kit adds 16K to your Apple II up to a total of 48K **$20.00**

THE PRIORITY 1 ELECTRONICS MEMORY EXPANSION KIT

Don't program without it.

NEWDOS80

A NEW ENHANCED NEWDOS FOR THE TRS-80® MODEL 1 FOR THE 1980's

NEWDOS80 is the most powerful Disk Operating System for the TRS-80. Among its many features is its ability to support 35. 40. 77 or 80 track 5¼" disks and 8" disks in any combination. NewDos 80 is designed for the sophisticated user and professional programmer who demands the ultimate in disk operating systems.

PART NO.	DESCRIPTION	PRICE
APP395	Supplied on 35 track	**$149.00**
APP39577	Supplied on 77 track	**$159.00**
	IF SIMULTANEOUSLY PURCHASED WITH A MICROPOLIS DISK DRIVE...	
APP395M	Supplied on 35 track	**$100.00**
APP395M77	Supplied on 77 track	**$110.00**

MICROPOLIS™

77 TRACK TRS-80 ADD-ON FLOPPY DISK DRIVES

We now have a complete line of TRS-80* Model 1 compatible MICROPOLIS add one drives in matching colors. These drives simply plug into the expansion interface via a disc data cable.

197K BYTES PER SIDE FOR YOUR TRS-80*, that's easy! Just order a 77 track add on drive and the New DOS-80 operating system. Among the many features of New DOS-80. is its ability to control any mix of 35. 40. 77 track drives on the same cable.

Order NEW DOS-80 40. 77. or 80 track drives on the same cablc.

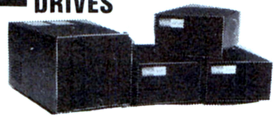
FEATURES:

- Capacity per drive: MOD II: 197K bytes formatted.
- Transfer rate: 125K bits/second
- Average rotational latency time: 100 milliseconds (ms)
- Access time - track-to-track: 30 ms.
- Head load time: 75 ms.
- Head positioner: stepper motor with lead screw drive.
- Drive motor start time: 1 second
- Rotational speed: 300 RPM
- Recording density: 2624 bits per inch (BPI) MOD II
- Recording mode: double frequency.
- Track density. MOD II: 100 tracks per inch (TPI).
- Surfaces used per diskette: 1
- 120 day warranty

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
MCP1027M2	77 Track Single	$689	**$439**
MCP1037M2	77 Track Dual	$1307	**$850**

77 Track Single. SH. WT. 15 lbs.
77 Track Dual. SH. WT. 30 lbs.

Vista MINIFLOPPY DISK DRIVES



The Vista Computer Company. a leader in the computer industry. once again meets the increased storage requirement of the computer user. With the introduction of the complete family of V80/800/8000 disk drive systems. Vista offers a complete hardware/software package that promises to eliminate your present storage problems and save you money too!

Compare this: With Single and Dual 40 and 80 track drives available. Vista's Family of Disk Drives provide up to four times the storage capacity found on other competitive units. Totally compatible with all TRS-80* Model I/III/Color software. the V80/800/8000 Family is also compatible and fully interchangeable with disk drives used on most other popular microcomputer systems. (Northstar. Exidy. Texas Instruments. Zenith) to name a few.

Dual-drive subsystems also reduce the time involved with making copies and back-ups by eliminating the need for constant removal and insertion of diskettes in a single drive system. On most systems. actual usable storage is increased by much more than double since the second drive can be totally dedicated to data and program storage without an operating system occupying part of the diskette.

FEATURES:

- Upgrade your system with increased storage and speed.
- Vista offers from 102K to 816K bytes on a single drive.
- The V80 operates at 5ms track access versus 40ms for competitive units.
- **Totally compatible with several microcomputers including TRS-80*. Northstar. Exidy. Texas Instruments. Heath/Zenith and others.**
- Diskette ejection system normally found only on 8" floppy disk drives
- Industrial quality. scratch-resistant cabinets for enduring looks and performance.
- Dual-head technology on the V800/8000 allows on-line use of both sides of diskettes
- Fastest track-to-track access time of any minifloppy disk drive - 5 milliseconds.
- Drives are interchangeable for any location from Drive 0 thru Drive 3.
- Proprietary diskette clamping mechanism provides the most accurate positioning and longest media life.
- Immediate delivery.
- 120 day warranty

PART NO.	CAPACITY	NO. DRIVES	TRACKS	SIDES	LIST PRICE	OUR PRICE
VISV80	102K	1 B51	40	1	395.00	**360.00**
VISV800	204K	1 B52	40	2	595.00	**540.00**
VISV801	204K	1 B91	80	1	595.00	**540.00**
VISV8000	408K	1 B92	80	2	775.00	**695.00**
VISV802	204K/408K	2 B51	40	1	775.00	**695.00**
VISV8002	408K/816K	2 B52	40	2	1095.00	**995.00**
VISV8012	408K/816K	2 B91	80	1	1095.00	**995.00**
VISV8002	816K/1.6M	2 B92	80	2	1495.00	**1350.00**

Order Disk Drive Data Cables on Page 8

Novation

AUTO-CAT™ AUTOMATIC ANSWER DIRECT CONNECT MODEM

1 ONE

The AUTO-CAT is Novation's price/performance champion in a low cost auto answer. FCC approved. direct connect modem. Not only does AUTO-CAT communicate data over all telephone networks but it will automatically answer each call.

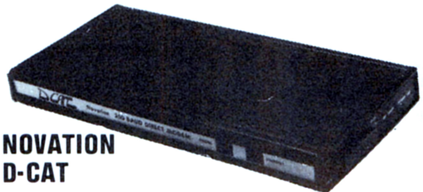
AUTO-CAT has all the most wanted features. It is compatible with any Bell 100 series modem, with data exchange up to 30 characters per second. The low power operation allows AUTO-CAT to be responsive to calls round-the-clock. Pressure sensitive switches can be set at the slightest touch to control its answer or originate operations. Reliable LED's give constant unit status and even pulsate during major modes of operation including a complete self-test.

AUTO-CAT SPECIFICATIONS:

Data Rate: 0 to 300 Baud. **Compatibility:** Bell 100 Series. **Interface:** EIA RS232C. **Operating Modes:** Auto answer/Manual Answer/Manual Originate. **Communication Modes:** Full or Half Duplex. **Test Modes:** Local and Remote Loop-back/ **Phone Line Interfaces:** Direct-Connect per FCC Part 68. Modular plug mates with standard telephone modular jack (USOC-RJ11C). **FCC Registration:** AU492X-69442-DP-E: Ringer Equivalence: 0.8B. **Indicators:** Power/Transmit data: Line/Test: Ready/Receive Data. **Size:** 10" Lg. x 4.7" W. x 1.2" H. **Weight:** 12 ounces.

Shipping Weight: 3 lbs.

	LIST PRICE	OUR PRICE
NOVAUTOCAT	$249.00	**$239.00**



NOVATION D-CAT

Novation proudly announces a worthy complement to the famous CAT TM. It's the D-CAT. The first directly coupled modem with the portability. ease of use and low cost of an acoustic. D-CAT is the only direct modem that is FCC approved for handset jack conection with any modular phone. It operates with either single or multi-line telephones without the need of adapters.

Data Rate: 0-300 Baud. **Compatibility:** Bell 100 series. **Interface:** EIS RS232C. **Modes:** Data. Talk. Monitor. Normal and Test. **Duplex:** Half. Full. **Indicators:** Ready. Power.

Shipping Weight: 3 lbs.

YOU MUST HAVE A PHONE WITH MODULAR HANDSET CONNECTORS.

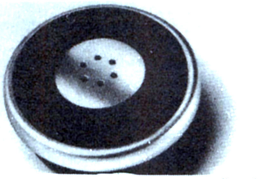
PART NO.	LIST PRICE	OUR PRICE
NOVDCAT	$199.00	**$189.00**

NOVATION CAT MODEM

- 0-300 Baud.
- Bell 103.
- Answer. Originate.

PART NO.	LIST PRICE	OUR PRICE
NOVCAT	$198.00	**$175.00**

Super Mike



SUPER MIKE transmits pure. clear data up to five times more efficiently through any acoustic coupler. SUPER MIKE does away with the carbon granule packing problems found in standard handset microphones. These constantly shifting particles can cause significant dB loss in reproduction levels from telephone to telephone.

SUPER MIKE SPECIFICATIONS:

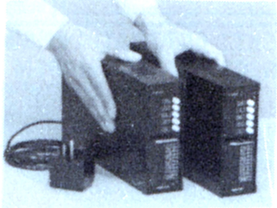
FCC Registration No. AU492X-67225-KX-N
Handsets. For Use Only on Western Electric 500 Compatible Telephones.
Sensitivity: 18dB/10 M BAT @ 100Hz.
Harmonics: Distortion 40dB Down Relative to Transmission Level

NOVMIKE **$16.95**

WE ACCEPT VISA, and MASTER CARD

PRIORITY ONE ELECTRONICS

PRENTICE Direct and Acoustic Modems



They're Bell Compatible But You Don't Have to Lease Them From Bell.

Interested in an improved version of the Bell System 212A data set? Prentice Corporation offers you two-the P-212A and the P-212C. Bell's 212A requires a substantial installation charge for both the modem and the special telephone, and on-going lease payments for each. The Prentice units require only a 502-or 503-type exclusion key telephone set, or a standard business phone with our inexpensive voice data switch (VDS-100). Either of these is less costly than the Bell alternative.

THE IMPROVED 212

The Prentice P-212A data modem incorporates LSI components to provide higher reliability and greater versatility than were possible before. The P-212A provides full-duplex transmission of 300 bps of 1200 bps serial binary data over two-wire dial-up lines, and automatic speed selection in the answer mode allows the P-212A to adjust to match the transmission rate of the originating modem.

The P-212A is available in either stand-alone or rack mount configurations so that it can easily adapt to you particular application.

THE ULTIMATE 212

With the P-212C you get all of the features of the P-212A and a lot more. By adding a microprocessor package, Prentice has developed a modem that provides delayed busy-out which is activated through an ALB (Analog Loopback) switch or from the "make busy" signal at the EIA interface for each selected modem. This feature permits the user to take a modem out of service while a call is in progress without affecting the transmission of data. As soon as each line clears, the modem will automatically busy itself out for service. The P-212C also has the capacity for self-testing during idle modes, and, if it is defective, the modem automatically busies itself out. Whenever the P-212C does busy itself out, it provides a signal which can be connected to any alarm or indicating light. With its manual speed override feature, the operator is able to manually override the automatic speed selection, and to dedicate the modem to either 300 bps or 1200 bps operation whenever he wishes.

SPECIFICATIONS:

Date Rates; Low-speed Mode - 0 to 300 bps, asynchronous format. **High-speed Mode -** 1200 bps + 1.0% to 2.5%, character-asynchronous format. 1200 bps, synchronous format. **Character Length -** 9 or 10 bits, switch selectable. **Operating Mode -** Full duplex at all speeds. **Modulation -** 0-300 bps, FSK. 1200 bps, PSK. **Line Requirement -** 2-wire switched network. **Compatibility; Low Speed Mode -** Existing 300 baud FSK switched network data sets. **High-speed Mode -** Bell 212A data set. **Interface Voltages -** Per EIA RS-232C. **Test Modes; P-212A and P-212C -** Analog Loopback, Digital Loopback, Selt-test, Remote Digital Loopback. **P-212C only -** Automatic self-test and busy-out during idle mode. **Special Interface; Control Functions -** Speed mode indication through EIA interface. Local Analog Loop Test and/or make busy mode activation through EIA interface. Test mode control through EIA interface. Speed mode control through EIA interface. Remote digital loop activation through EIA interface. **AC Power -** 117 volts ± 10%, 60 Hz ± 5%, 9.5 VA maximum. **Weight; Stand-along Unit -** 5 pounds (2.3 kg). **Rack Mount Unit -** 1 pound, 6 ounces (0.6 kg). **Wall Mount Transformer -** 14 ounces (0.4 kg). **Dimensions; Stand-alone Unit -** Height 2.3"; Width 6.37"; Depth 11.65". **Rack Mount Unit -** Height 7.0"; Width 19.0"; Depth 11.65". **FCC Registraiton Number -** A0794S-67622-DM-N.

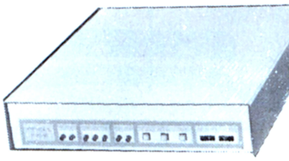
PART NO.	DESCRIPTION	PRICE
PRNP212ASA	Orig./Auto Ans.-Stand Alone	$795.00
PRNP212ARM	Orig./Auto Ans.-Rack Mount	$710.00
P212C With Microprocessor Diagnostic Features		
PRNP212CSA	Orig./Auto Ans.-Stand Alone	$810.00
PRNP212CRM	Orig./Auto Ans-Rack Mount	$725.00

Order cables or Voice/Data Switch and Rack Mount enclosures and power supplies below.

VDS 100 VOICE DATA SWITCH

Provides the portability of an acoustic coupler. Allows Prentice data sets, designed for switched network use, to be connected to the network by a standard business telephone. Allows voice or data mode, with auto-answer capability in data mode (where supported by the data set). Eliminates the need to use Bell 502 or 503 exclusion key telephone sets in conjunction with modems. Offers significant cost savings. Operates with permissive connection (VF Cable Type J).

PART NO.	DESCRIPTION	PRICE
PRNVDS100	Voice Data Switch	$35.00
TYPE J PERMISSIVE CABLE		
PRNCPER7	7', mates with RJ11C, RJ41, & RJ45 jacks	$10.00
TYPE K PROGRAMMABLE CABLE		
PRNCPR07	7", mates with RJ41 or RJ45 jacks	$10.00
TYPE B RACK MOUNT ENCLOSURES AND POWER SUPPLIES FOR P212 MODEMS		
PRNP853	19" Rack for 8 modems	$240.00
PRNP900	19" Rack for 3 P950 Power Supplies	$125.00
PRNP950	Power Supply Module for up to 8 Modems	$225.00



P201C PRIVATE LINE/DIAL MODEM

FEATURES:

- Full duplex 2400 bps synchronous modem.
- Direct connect to DDD network per FCC Rules, Part 68.
- Compatible with Bell 201 B/C.
- Superior performance on unconditioned type 3002 leased lines and direct dial distance network.
- Microprocessor-based design.
- Provides a variety of switch and strap selected operating configurations.
- Front panel indicators continuously display modem and EIA lead status.
- Built-in modem test circuit makes troubleshooting easy.
- Available in a stand-alone enclosure.

GENERAL DESCRIPTION:

The P-201C Private Line/Dial Modem is a synchronous, 2400 bps modem that is end-to-end compatible with Bell's 201 B/C data sets. Because it contains the necessary protective circuitry and is registered by the FCC, the P-201C can be directly connected to the direct distance dial network as well as the leased telephone lines. The P-201C is an economical alternative to the Bell 201 which maintains the high quality, reliability and performance typical of all Prentice products.

A variety of features makes the P-201C easy to use. FCC registration eliminates DAAs. The P-201C is available in foxed loss loop, permissive, or programmable modes. Standard rear panel connectors for the data terminal equipment, FCC registered telephones, and phone line make installation easy. On-board ring detect and answer-back circuitry enable completely automatic data transfers from remote sites.

SPECIFICATIONS:

Operation - Synchronous. **Modes -** Half-duplex on DDD lines, half-or full-duplex on leased lines. Receiver squelch selectable for operation on DDD lines. **Modulation -** Differential phase-shift keying (four phase): carrier 1800 Hz. **Terminal Interface -** EIA RS232C, CCITT V.24, V.28 compatible. **DDD Network Interface -** 600 Ohms balanced, rear panel RJ45S receptacle. **Telephone Set Interface -** Rear panel RJ11C receptacle for FCC registered telephone. **Private Line Interface -** 600 Ohm, 4-position terminal strip. **Data Rate -** 2400 bps. **Mechanical Dimensions -** 2.4 in (6.1 cm) H x 10.25 in (26.04 cm) W x 12.4 in (31.5 cm) D. **Weight -** 3 pounds (1.36 Kg). **Power Requirements -** Power supply for stand-alone requires 105-129 VAC, 57 to 63 Hz, 0.2 Amps. **FCC Registration No. -** ABV954-69841-D-M-E. **Ringer Equivalence -** 0.3B. **Clear-to-Send Delay -** 0, 8.5, 25, 150 msec after RTS or on continuously.

DIAGNOSTIC INDICATORS:

Each unit contains the following LED indicators on its front panel:

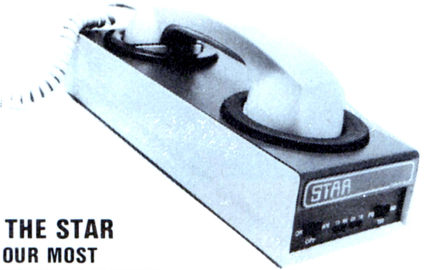
DCD	Data Varrier Detect	CTS	Clear-to-Send
RXD	Receive Data	RTS	Request-to-Send
TXD	Transmit Data	TST	Test and Error Detect
RI/OH	Ring Indicator/Off-Hook	PWR	Power (+ 5V present)

CONTROLS:

Each unit contains the following switch actuated front panel controls: **Talk -** In dial applications this pushbutton selects talk mode. **Data -** This pushbutton switches the modem from voice to data mode. **Answer/Originate -** In answer mode the modem will automatically answer. In originate mode the operator manually originates or manually answers calls. **Self-Test/Normal -** A momentary switch that puts the modem in self-test mode. **Digital Loopback/Normal/Analog Loopback -** A three-position switch that selects a ioop test or normal mode.

PRNP201C	Private Line/Dial Modem	$950.00
0-300 BPS ASYNCHRONOUS BELL COMPATIBLE MODEMS		
PRNP113DSA	Auto Ans. Only-Stand Alone	$395.00
PRNP113DRM	Auto Ans. Only-Rack Mount	$260.00
PRNP113CSA	Originate Only-Stand Alone	$385.00
PRNP113CRM	Originate Only-Rack Mount	$250.00
PRNP102JSA	Orig./Auto Ans.-Stand Alone	$470.00
PRNP103JRM	Orig./Auto Ans.-Rack Mount	$350.00
Order Cable Type J and K,for type A Rack Enclosures.		
0-1200 BPS ASYNCHRONOUS BELL COMPATIBLE MODEMS		
PRNP202SSA	Orig./Auto Ans.-Stand Alone	$455.00
PRNP202SRM	Orign./Auto Ans.-Rack Mount	$340.00
Order Cables Types J and K. Type A Rack Enclosure.		
PRNP202TSA	Leased Line-Stand Alone	$440.00
PRNP202TRM	Leased Line-Rack Mount	$325.00
Order cables types A and B. Type A Rack Enclosures.		
TYPE A 4 WIRE CABLES		
PRNC46P	6' with plug for 404B Jack	$10.00
PRNC46SL	6' with spade leads for 42A Block	$10.00
PRNC46MP	6' with Modular Plug	$10.00
TYPE B 2 WIRE CABLES		
PRNC26P	6' with Plug for 404B Jack	$10.00
PRNC26SL	6' with Spade Leads for 42A Block	$10.00
TYPE A RACK MOUNT ENCLOSURES WITH MODULAR POWER SUPPLIES		
PRNP813	19" Rack for 8 modems	$325.00
PRNP1613	19" rack for 16 modems	$650.00
PRNP812	Desk Top Enclosures for 8 Modems	$345.00

Prentice manufactures a complete line of data communications equipment. Please call for complete information on high speed modems, limited distance modems, and statistical multiplexers.



THE STAR OUR MOST POPULAR MODEM We've Sold Thousands!

The STAR puts a quality 300 bps RS232 modern within reach of the small computer user...the same modems selected by IBM, GE, RCA, and ADP.

CIRCUITRY:

The switchable, four-section bandpass filter provides the user with excellent out-of-band rejection to assure accurate processing of the received carrier, even at signal levels of less than -47 dBm. Further, the proven soft limiter and phase lock loop discriminator yields data that is essentially jitter free.

The crystal controlled oscillator in the STAR modem produces a nearly harmonic free carrier. The unique digital synthesizer assures stable carrier frequencies. The pureness of the resulting sine wave exceeds even the stringent harmonic requirements of all CCITT countries.

CARRIER DETECT:

To assure accurate teleprocessing connections, the carrier detect circuitry prevents the modem from attempting to operate when excessive noise would produce errors or cause marginal operation.

EXCLUSIVE ACOUSTIC CHAMBERS:

The exclusive triple seal of Prentice's new flat mounted cups locks the handset into the acoustic chamber yielding superior acoustic isolation and mechanical cushioning. Designed to adapt to most common handsets used throughout the world.

SELF TEST:

The self test feature on the STAR allows the user to verify total operation of the acoustic modem by using the terminal in the full duplex mode. No need for remote assistance in diagnosing terminal or modem problems.

SPECIFICATIONS:

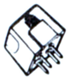
- **Data Rate:** 0 to 300 baud.
- **Compatibility:** Bell 103 and 113; CCITT.
- **Frequency Stability:** ±0.3 percent. Crystal controlled.
- **Receiver Sensitivity:** -50 dBm ON. -53 dBm OFF.
- **Modulation:** Frequency shift keyed (FSK).
- **Carrier Detect Delay:** 1.2 seconds ON; 120 msec OFF.
- **EIA Terminal Interface:** Compatible with RS 232 specifications.
- **Teletype Interface:** 20 milliampere current loop.
- **International (CCITT) frequencies available.**
- **Switches:** Orginate/Off/Answer; Full Duplex/Test/-Half Duplex.
- **Indicators:** Transmit Data, Receive Data, Carrier Ready, Test.
- **Power:** Supplied by 24 VAC/150 MA UL/CSA listed wallmount transformer. Input 115 VAC, 2.5 watts.
- **Dimensions:** 10" x 4" x 2".
- **Weight:** 1.74 lbs. (3 lbs. shipping weight including AC adaptor.)
- **Warranty:** ONE year on parts and labor, excluding the AC adaptor which carriers the manufacturer's warranty.

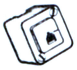
PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
PRNSTAR	RS232, TTL, 200Ma Current Loop	$199.00	$149.00
PRNSTAR-V21	CCITT European Standard	$229.00	$209.00

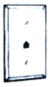
CABLES

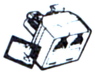
PART NO.	DESCRIPTION	PRICE
CNDRS2328F	RS232 8 Cond 8 Ft	$19.95
IDCCABLE12	RS232 25 Cond 3 ft	$14.95

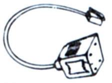
MODEM/TELEPHONE ACCESSORIES

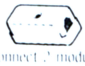

CALMTA1 $2.29

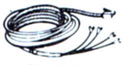

CALMTJ1 $3.98

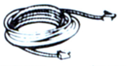

CALMTJ1W $2.49


CALMTA2 $3.19


CALMTA3 $4.39


Connect 2 modular cords together
CALMTC1 $3.99


7' CALMTC7PL $2.49
14' CALMTC14PL $3.19
25' CALMTC25PL $4.79


7' CALMTC7PP $2.79
14' CALMTC14PP $3.69
25' CALMTC25PP $5.29

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Verbatim®

NEW Datalife™ ONE
Means 7 data-shielding improvements for greater durability, longer life.

Datalife
flexible disks
Verbatim
Verbatim
flexible disks

Introducing 7 data-shielding improvements from Verbatim for greater disk durability, longer data life.

1. A longer-lasting lubricant.
Protect against data-destroying head to disk contact.

2. An improved liner.
Removes debris better. It also enables more lubricant to reach the recording head, protecting against head wear.

3. A thicker, more durable coating.
For more adhesive and cohesive strength and an optimized signal resolution for the new recording heads.

4. Advanced polishing techniques.
Make our discs uniformly smooth, for better data transfer, less head wear.

5. Reinforcing hub rings.
To aid in registration, eliminating slippage, reduce errors, and give better alignment repeatability.

6. Testing standards that go far beyond Industry standards.
Every Verbatim disk meets or exceeds the most demanding of IBM, Shugart, ANSI, ECMA and ISO standards-because we insist on Verbatim being the industry standard of excellence.

All to insure that Verbatim disks always pass the ultimate test: satisfying you.

7. A 100% Error-Free Certification that means more than just "100% error-free."
Our certification isn't based on random sampling or statistical averaging. Rather, it's based on extensively testing every single disk. So we can state that our disks really are 100% error-free.

5¼" DISKETTES

PART NO.	SECTORING	APPLICATION	SIDES	BOX OF 10
VRBMD52501	Soft Sector	TRS-80 Apple/40 Track Cert.	1	**$32.00**
VRBMD52510	Hard 10 Sector	North Star/40 Track Cert	1	**$32.00**
VRBMD52516	Hard 16 Sector	Micropolis/40 Track Cert	1	**$32.00**
VRBMD55701	Soft Sector	77 Track Cert/100 TPI	2	**$56.00**
VRBMD55710	Hard 10 Sector	77 Track Cert/100 TPI	2	**$56.00**
VRBMD55716	Hard 16 Sector	77 Track Cert/100 TPI	2	**$56.00**
VRBMD57701	Soft Sector	77 Track Cert/100 TPI	1	**$48.00**
VRBMD57710	Hard 10 Sector	77 Track Cert/100 TPI	1	**$48.00**
VRBMD57716	Hard 16 Sector	77 Track Cert/100 TPI	1	**$48.00**

VRBMD Series comes with reinforced hub ring mounted.
ALL VERBATIM 5¼" DISKETTES ARE DOUBLE DENSITY CERTIFIED

8" DISKETTES

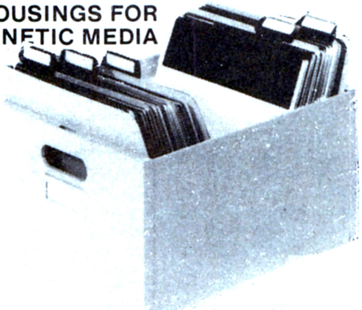
PART NO.	SECTORING	APPLICATION	SIDES	BOX OF 10
VRBFD32	Hard Sector	Shugart 801R	1	**$37.00**
VRBFD34	Soft Sector	IBM 3740	1	**$37.00**
VRBFD32-2	Hard Sector	Flippy	1	**$66.00**
VRBFD34-2	Soft Sector	Flippy	1	**$66.00**

The above Verbatim 8" Diskettes have all the Datalife improvements without the hardhole reinforcement rings.

PART NO.	SECTORING	APPLICATION	SIDES	BOX OF 10
VRB328	Hard Sector	Dbl Density	1	**$57.00**
VRB348	Soft Sector	Dbl Density	1	**$57.00**
VRB324	Hard Sector	Dbl Density	2	**$67.00**
VRB344	Soft Sector	Dbl Density	2	**$67.00**

The above 8" Diskettes come in a hard box with reinforced hub rings mounted.

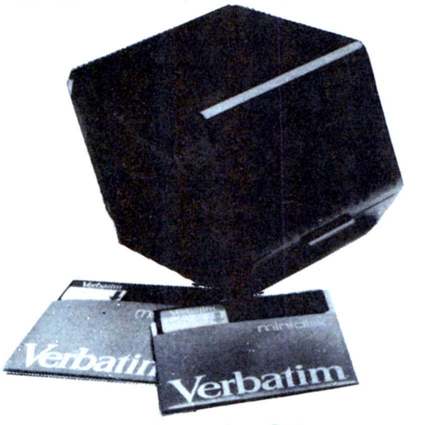
HOUSINGS FOR MAGNETIC MEDIA



- Vinyl dust cover
- 5 pressboard dividers
- 3 metal dividers
- Will cross-file in a standard letter-size file drawer
- Capacity: 50 diskettes

Shipping weight: MM-1 5 lbs. FM-2 9lbs.

MMMMM1	(for 5¼" diskettes)	**$28.50**
MMMFM2	(for 8" diskettes)	**$37.00**



THE PROTECTOR.

- Capacity: 50 Diskettes
- Sizes for 8" and 5¼" Diskettes
- Rugged, smoked plexiglass construction
- Helps keep dust, dirt and grime from contaminating valuable diskettes

Shipping Weight: **VRBPRT5** 3 lbs. **VRBPRT8** 5 lbs.

PART NO.	DESCRIPTION	PRICE
VRBPRT5	For 5¼" Diskettes	**$29.95**
VRBPRT8	For 8	**$39.95**

DON'T LET DUST OR SCRATCHES DIRTY YOUR DATA!

3M Scotch BRAND

If it's worth remembering, it's worth

3M
diskettes
diskettes

SCOTCH RECORDING PRODUCTS.

DISKETTES

PART NO.	SIDES/ DENS. SECTORING	LIST PRICE BOX/10	PRICE BOX/10
	8"		
MMM740-0	1/sgl Soft-IBM	$ 50.00	**$39.95**
MMM740/2-0	2/sgl Soft-IBM	$ 88.00	**$75.00**
MMM740-32	1/sgl 32-Shugart 801	$ 50.00	**$39.95**
MMM740/232	2/sgl 32-Shugart 801	$ 88.00	**$75.00**
MMM741-0l	1/dbl Soft-Shugart Dbl	$ 70.00	**$59.00**
MMM7430	2/dbl (2hd) Soft-IBM	$100.00	**$88.00**
	5"		
MMM744-0	1/sgl Soft-Shugart SA400 (TRS-80)	$ 50.00	**$39.95**
MMM744-10	1/sgl Soft/10 SA400	$ 50.00	**$39.95**
MMM744-16	/sgl Soft/16 Micropolis	$ 50.00	**$39.95**
MMM74501	2/dbl Soft Sector	NEW	**CALL**
MMM74510	2/dbl 10 Sector	NEW	**CALL**
MMM74516	2/dbl 16 Sector	NEW	**CALL**

BE SURE TO ORDER YOUR KASETTE/10 LIBRARY CASE

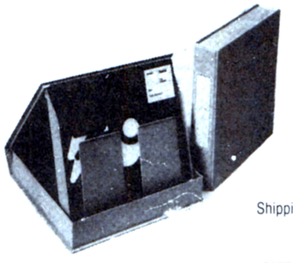
HARDHOLE HUB REINFORCING DISK PROTECTORS

- Protects disks and diskettes from wear!
- Repairs damaged disks!

Now you can save those "ruined" disks with simple insertion of our DISK PROTECTOR! Inserting a protector on a new disk will increase its life times over! Easy to install, just slip a protector ring onto the precision tool then slip on the disk! No glueing, no drying time, no heat! One tool lasts indefinately, each disk requires one protector ring.

PART NO.	DESCRIPTION	PRICE
VRBHDHL5	5¼" Diskette Protector Ring (pkg. 50)	**$ 7.00**
VRBHDHL5A	5¼" Applicator Tool	**$ 3.50**
VRBHDHL8	8" Diskette Protector Rings (pkg. 50)	**$10.00**
VRDHDHL8A	8" Applicator Tool	**$ 5.00**

Shipping Weight: 4 oz.



KASETTE/10 LIBRARY CASE

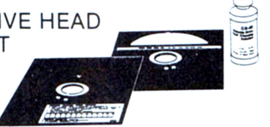
Shipping Weight: 8" 2 lbs.
5¼" 1 lb.

PART NO.	SIZE	COLOR	PRICE
MMMKS10GY	8"	Grey	**$4.50**
MMMKS10BK	8"	Black	**$4.50**
MMMKS10BU	8"	Blue	**$4.50**
MMMKS10BG	8"	Beige	**$4.50**
MMMKM10GY	5¼"	Grey	**$4.25**
MMMKM10BK	5¼"	Black	**$4.25**
MMMKM10BU	5¼"	Blue	**$4.25**
MMMKM10BG	5¼"	Beige	**$4.25**

PREVENT HEAD CRASHES

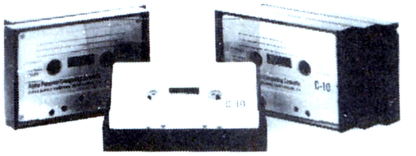
A one year supply of disk cleaning supplies cost $29.95—What is a diskette with one of your programs worth?

DISKETTE DRIVE HEAD CLEANING KIT



Diskette drive heads, like your cassette heads, need periodic maintenance to assure efficient and error-free operation. Unlike other peripheral devices, the read/write head(s) on diskette drives are extremely difficult to clean without partially disassembling the drive. The unique concept of the diskette head cleaning kit allows the user to clean the drive heads without disassembly in just minutes. Available for 8" or 5¼", both single and double sided disk drives. Kit contains 2 cleaning diskettes, a 4 oz. bottle of CS-85 cleaning solution and easy-pour dispenser. Wt. 12 oz. A 1 year supply if you clean your disk once a week.

CATALOG NO.	DESCRIPTION	PRICE
VRBFD08	8" Disk Drive Cleaning Kit	**$29.95**
VRBFD05	5¼" Disk Drive Cleaning Kit	**$29.95**



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MMMPCC10	10 Minute	**$1.30**
MMMPCC20	20 Minute	**$1.40**
MMMPCC30	30 Minute	**$1.50**

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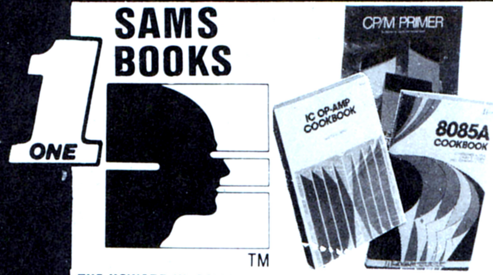
PRIORITY ONE ELECTRONICS

SAMS BOOKS



THE HOWARD W. SAMS CRASH COURSE IN COMPUTERS
by Louis E. Frenzel, Jr. Designed to meet the computer challenge to the '80's, this course is arranged as a series of lessons in a unique self-teaching format. The programmed instruction test is a quick and effective way to learn the basics, numbers systems, memories, architecture, input/output devices, software programming, and applications. Written for the lay person as well as scientists, engineers, or technicians. 264 pages; 8½ x 11; wirebound.
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MICROCOMPUTER PRIMER (2nd Edition)
by Mitchell Waite and Michael Pardee. Describes the newest advances in microprocessor technology including information on VLSI chips, 16-bit micros, and new interface devices.384 pages; 5½ x 8½; softbound.
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by Louis E. Frenzel, Jr. This self-instructional book will aid you to obtain an in-depth knowledge of microcomputers, using the Microcomputer Learning Laboratory described in the book. 288 pages; 5½ x 8½; softbound.
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by Mitchell Waite and Michael Pardee. Updated and expanded . . . this book covers buying your first computer, buzz words, applications, programs, and the nuts and bolts of a computer. Thirty popular personal and small business computers are compared. 224 pages; 5½ x 8½; softbound.
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by William Barden, Jr. Contains all the information needed for the prospective buyer of a small computer to make a wise selection from 21 popular systems described. 128 pages; 5½ x 8½; softbound.
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by William Barden Jr. Covers everything the business owner needs to know from types of microcomputers available to pitfalls to avoid. 256 pages; 5½ x 8½; softbound.
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BASIC BUSINESS SOFTWARE
by E.G. Brooner. Written especially for today's small business owner who is not a computer expert, this book focuses on the fundamentals of business software development. Shows how business software is written, so you can either write some of your own, or evaluate those programs that are available from other sources. 144 pages; 5½ x 8½; softbound.
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THE S-100 AND OTHER MICRO BUSES
by Elmer C. Poe and James C. Goodwin. From discussing the basics of buses to examining in detail the various ways to convert different bus signals to S-100 signals; this guide covers it all. 5½ x 8½; softbound.
SAM 21810.................................... **$7.95**

INTERFACING TO S-100 (IEEE 696) MICROCOMPUTERS
by Sol Libes and Mark Garetz. This book assists S-100 users in expanding the power and utility of their systems. It describes the S-100 bus with unmatched precision and detail. Various chapters describe its mechanical and functional design, logical and electrical relationships, bus interconnections, and bussing techniques. Both parallel and serial interfacing are described as well as interfacing to RAM, ROM, and the real world. Additional chapters discuss D/A and A/D conversion, interrupts, timers and direct memory access.
GBT373.................................... **$15.00**

CP/M PRIMER
by Steven Murtha and Mitchell Waite. For the more inquisitive person who wants to know not only the operating mechanics of CP/M but also why CP/M works the way it does. Appendix A explains the internal operation of CP/M. 92 pages; 8½ x 11; spiral bound.
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THE CP/M HANDBOOK (WITH MP/M)
by Rodnay Zaks. 336 pp., 100 Illustr. Ref.
A complete guide and reference handbook for CP/M— the industry standard in operating systems. Step-by-step instruction for everything from turning on the system and inserting the diskette to correct user discipline and remedial action for problem situations. Includes a comprehensive description of all CP/M facilities and resources, instructions for advanced operations and complete discussions of all versions of CP/M up to and including 2.2, MP/M and CDOS.
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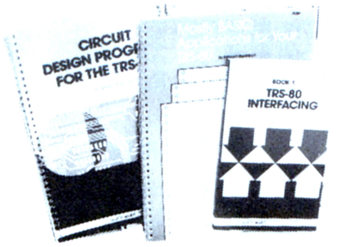

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COM5016	5068 Baud Rate Generator	15.95

KEYBOARD ENCODERS

PART NO.	DESCRIPTION	PRICE
AY23276	88 Key ASCII 8 Bit	$13.95
AY33600	90 Key ASCII 10 Bitr	13.95

SPST DIP SWITCHES

PART NO.	NO. OF POSITIONS	PRICE 1-9	10-24	25-99
DIPSW4	4	$1.50	$1.40	$1.28
DIPSW5	5	1.60	1.49	1.36
DIPSW6	6	1.70	1.59	1.45
DIPSW7	7	1.80	1.68	1.53
DIPSW8	8	2.00	1.86	1.70
DIPSW9	9	2.25	2.10	1.92
DIPSW10	10	2.50	2.33	2.12

CRYSTALS

PART NO/FREQ.	APPLICATION	1-9	10-24
XTL1.000MH	6800CPU, Std. Clock	$4.95	$4.45
XTL1.843MH	4411 Baud Rate Gen.	4.95	4.45
XTL2.000MH	Z80 CPU, Std. Clock	4.95	4.45
XTL3.000MH	Standard Clock Freq.	4.95	4.45
XTL3.276MH	ICM7025 Stopwatch	4.95	4.45
XTL3.579MH	TV Color Burst SM Case	3.95	3.50
XTL4.000MH	Z80A CPU, Std Clock	3.95	3.50
XTL5.068MH	Baud Rate Generator	3.95	3.50
XTL6.000MH	Standard Clock Freq.	3.95	3.50
XTL10.00MH	Standard Clock Freq.	3.95	3.50
XTL18.00MH	8080, 8008, 8224	3.95	3.50
XTL20.00MH	Standard Clock Freq.	3.95	3.50

74LS TTL

PART NO.	DESCRIPTION	PRICE
74LS00	Quad 2-In Nand Gate	$ .40
74LS01	Quad 2-In. Nand Gate (OC)	.40
74LS02	Quad 2-In Nor Gate (OC)	.40
74LS03	Quad 2-In. Nand Gate (OC)	.40
74LS04	Hex Inv.	.42
74LS05	Hex Inv.	.42
74LS08	Quad 2-In and Gate	.40
74LS09	Quad 2-In Nand Gate (OC)	.40
74LS10	Trip 3-In. Nand	.40
74LS11	Trip 3-In. And	.42
74LS12	Trip 3-In Nand Gate (OC)	.42
74LS13	Dual Schmitt Trig	.78
74LS14	Hex Schmitt Trig	.95
74LS15	Trip 3-In. Nand	.42
74LS20	Dual 4-In. Nand Gate	.40
74LS21	Dual 4-In. Nand Gate	.40
74LS22	Dual 4-In Nand Gate (OC)	.40
74LS26	Quad 2-In Nand Gate (HV)	.42
74LS27	Trip 3-In Nor Gate	.42
74LS30	Sngl 8-In Nand Gate	.40
74LS32	Quad 2-In Or Gate	.40
74LS37	Quad 2-In Nand Buff	.46
74LS38	Quad 2-In Nand Buff (OC)	.46
74LS40	Dual 4-In Nand Buff	.42
74LS42	BCD-Decimal Decoder/Driver	.92
74LS47	BCD-7 Segmt Decoder/Driver	1.10
74LS48	BCD-7 Segmt Decoder/Driver	1.09
74LS49	BCD 7 Segmt Decoder/Driver	1.00
74LS51	Quad 2-In And-Or-Inv Gate	.40
74LS54	Quad 2-In And-Or-Inv Gate	.40
74LS55	Dual 4-In And-Or-Inv Gate	.40
74LS73	Dual J-F F/F W/Preset + Clr	.60
74LS74	Dual "D" F/F	.58
74LS75	Quad Latch	.82
74LS76	Dual J-K F/F W/Preset + Clr	.62

74LS TTL

74LS78	Dual J-F F/F W/Preset	$ .63
74LS83	4-Bit Full Add	.89
74LS85	4-Bit Mag Comp	.94
74LS86	Quad Ex-Or Gate	.58
74LS90	Binary Counter	.70
74LS93	Binary Counter	.70
74LS107	Dual J-K F/F W/Corner Pwr Pins	.62
74LS109	Dual J-K F/F Pos Edge	.60
74LS112	Dual J-K F/F Neg Edge	.62
74LS113	Dual J-K F/F Neg Edge	.62
74LS114	Dual J-K F/F Neg Edge	.62
74LS122	Retriggerable Mon Multivibrator	1.00
74LS123	Dual Retrig. Mono. Multivibrator	1.00
74LS125	Quad Buff (TS)	.74
74LS126	Quad Buff (TS)	.74
74LS132	Quad Schmitt Trig	.75
74LS136	Quad Ex-Or Gate	.69
74LS138	Exp. Sngl ⅜ Decoder	.80
74LS139	Exp. Dual 2/4 Decoder	.80
74LS151	Sngl 8-1 Mux	.65
74LS153	Dual 4-1 Mux	.84
74LS154	Sngl 4-16 Decoder	2.10
74LS155	Dual 2-4 Demux	.90
74LS156	Dual 2-4 Demux (OC)	1.55
74LS157	Quad 2-1 Mux	.84
74LS158	Quad 2-1 Mux (Inv Out)	.95
74LS160	Preset Decade Ctr	1.20
79LS161	Preset Binary Ctr	1.20
74LS162	Preset Decade Ctr (Syn Clr)	.89
74LS163	Preset Decade Ctr (Syn Clr)	1.20
74LS164	8-Bit S/R	.90
74LS168	Syn Decade U/D Ctr	2.20
74LS169	Syn Binary U/D Ctr	2.95
74LS170	4x4 Reg File	2.00

74LS TTL

PART NO.	DESCRIPTION	PRICE
74LS173	Quad "D" Reg (TS)	$1.00
74LS174	Hex "D" F/F	.75
74LS175	Quad "D" F/F	.75
74LS190	U/D Decade Ctr	1.00
74LS191	U/D Binary Ctr	1.20
74LS192	U/D Decade Binary	1.00
74LS193	U/D Binary Ctr	1.20
74LS196	Preset Decade Ctr	1.00
74LS197	Preset Binary Ctr	1.98
74LS221	Dual Mono. Multivibrator (Sch Trg)	1.70
74LS240	Octal Inv Bus/Line Drvr	2.00
74LS241	Octal Bus/Line Drvr	2.00
74LS242	Quad Bus Trscvr/Inv	2.81
74LS243	Quad Bus Trscvr	2.00
74LS24	Octal 3 Stat Drvr	2.00
74LS245	Octal Bus Trscvr	2.10
74LS247	BCD-7 Segmt Decoder/Driver	1.68
74LS253	Dual 4-In Mux (TS)	.75
74LS257	Quad 2-In Mux	.85
74LS258	Quad 2/1 Mux	1.00
74LS266	Quad Ex-Nor Gate	.66
74LS279	Quad Set/Reset Latch	.88
74LS283	4-Bit Full Add	.95
74LS299	Four Bit Binary Counter	2.62
74LS365	Hex Buff (TS)	.88
74LS366	Hex Inv (TS)	.88
74LS367	Hex Buff (4-2) TS	.75
74LS368	Hex Inv (4-2) TS	.75
74LS373	Tri-State Octal D-Flip-Flop	1.80
74LS374	Tri-State Octal D-Flip-Flop	1.80
74LS386	Quad Ex-Or Gate	.69
74LS670	4x4 Reg File (TS)	2.31

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PRIORITY ONE ELECTRONICS

74 TTL

PART NO.	DESCRIPTION	PRICE
7400	QUAD TWO-INPUT GATE	$ .32
7401	QUAD TWO-INPUT GATE (OPEN COLL)	.32
7402	QUAD TWO-INPUT NOR GATE	.32
7403	QUAD TWO-INPUT GATE (OPEN COLL)	.32
7404	HEX INVERTER	.36
7405	HEX INVERTER (OPEN COLL)	.36
7406	30V-40MA HEX INVERTER	.45
7407	30V-40MA HEX BUFFER	.45
7408	QUAD 2-INPUT POSITIVE AND GATE	.32
7409	QUAD 2-INPUT AND GATE (OC)	.32
7410	TRIPLE THREE-INPUT GATE	.32
7411	TRIPLE THREE-INPUT AND GATE	.32
7413	DUAL SCHMITT TRIGGER	.54
7414	HEX SCHMITT TRIGGER	1.25
7416	15V-40MA HEX INVERTER	.45
7417	15V-40MA HEX BUFFER	.45
7420	DUAL FOUR-INPUT GATE	.32
7423	EXPAND DUAL FOUR-INPUT NOR GATE	.36
7425	DUAL FOUR-INPUT NOR GATE	.36
7426	QUAD 2-INPUT INTERFACE NAND GATE	.36
7427	TRIPLE THREE-INPUT NOR GATE	.36
7430	EIGHT-INPUT GATE	.32
7432	QUAD 2-INPUT OR GATE	.36
7437	QUAD TWO-INPUT NAND BUFFER	.42
7438	QUAD 2-INPUT NAND BUFFER (OC)	.42
7440	DUAL FOUR-INPUT BUFFER	.32
7441	BCD-DECIMAL DECODER/DRIVER (NIXIE)	1.30
7442	BCD-TO-DECIMAL DECODER	.77
7445	BCD-TO-DECIMAL DECODER/DRIVER	1.43
7446	BCD-7 SEG DECODER/DRIVER (30 VOLT)	1.32
7447	BCD-7 SEG DECODER/DRIVER (15 VOLT)	1.32
7448	BCD-7 SEG DECODER/DRIVER (ACTIVEHI)	1.32
7450	EXPAN. DUAL AND-OR-INVERT GATE	.32
7451	DUAL AND-OR-INVERT GATE	.32
7453	EXPANDABLE AND-OR-INVERT GATE	.32

PART NO.	DESCRIPTION	PRICE
7454	AND-OR-INVERT GATE	$ .32
7460	DUAL FOUR INPUT EXPANDER	.32
7470	EDGE-TRIGGERED J-K FLIP-FLOP	.50
7472	J-K MASTER SLAVE FLIP-FLOP	.45
7473	DUAL J-K FLIP-FLOP	.45
7474	DUAL D FLIP-FLOP	.45
7475	QUAD LATCH	.73
7476	DUAL J-K FLIP-FLOP	.45
7483	4-BIT BINARY FULL ADDER	.99
7485	FOUR-BIT MAGNITUDE COMPARATOR	1.30
7486	QUAD EXCLUSIVE-OR GATE	.40
7489	64 BIT RAM O.C.	2.98
7490	DECADE COUNTER	.73
7491	SERIAL-IN, SERIAL-OUT 8-BIT SHIFT REG	.99
7492	DIVIDE-BY-TWELVE COUNTER	.73
7493	FOUR-BIT BINARY COUNTER	.73
7495	4-BIT RIGHT-SHIFT, LEFT-SHIFT REGIST	.88
7496	5-BIT SHIFT REG. (PARA-IN, PARA-OUT)	.99
74107	DUAL J-K FLIP-FLOP	.99
74109	DUAL J-K FLIP-FLOP (FSC 9024)	.50
74121	ONE SHOT	.50
74123	DUAL ONE SHOT	.77
74125	TRI STATE QUAD BUFFER (DM8093)	.59
74126	TRI STATE QUAD BUFFER (DM8094)	.59
74132	QUAD SCHMITT TRIGGER	.99
74141	NIXIE DRIVER	1.25
74145	BCD TO DECIMAL DECODER DRIVER	1.21
74147	10/4 PRIORITY ENCODER	1.98
74148	8/3 PRIORITY ENCODER (9318)	1.98
74150	SIXTEEN LINE MULTIPLEXER	1.50
74151	EIGHT LINE MULTIPLEXER	1.10
74153	DUAL FOUR-INPUT MULTIPLEXER	1.10
74154	4 TO 16 LINE DECODE/DEMUX	1.65
74155	DUAL 2 TO 4 DEMULTIPLEXER	.99
74156	DUAL 2 TO 4 DEMUX (OC)	1.21

PART NO.	DESCRIPTION	PRICE
74157	QUAD 2-INPUT MULTIPLEXER (9322)	1.10
74160	PRESETTABLE DECADE COUNTER (9310)	1.32
74161	PRESET. DECADE BINARY COUNTER (9316)	1.32
74162	PRESET. DECADE CTR (SYNCH CLEAR)	1.32
74163	PRESET. BINARY CTR (SYNCH CLEAR)	1.32
74164	SERIAL-IN, PARA-OUT 8-BIT SHIFT REG	1.43
74165	PARA-IN, SERIAL-OUT 8-BIT SHIFT REG	1.43
74166	8-BIT SHIFT REGISTER	1.43
74170	4 x 4 REGISTER FILE	2.42
74173	TRI ST. QUAD K F-FLOP (DM8551N)	1.80
74174	HEX D FLIP-FLOP	1.21
74175	QUAD D FLIP-FLOP	1.21
74176	PRESET DECADE COUNTER (DM8280)	1.32
74177	PRESET BINARY COUNTER (DM8281)	1.32
74180	PARITY GENERATOR/CHECKER	1.21
74181	ARITHMETIC LOGIC UNIT	2.75
74182	CARRY LOOK AHEAD	1.10
74184	BCD-TO-BINARY COUNTER	2.10
74185	BINARY-TO-BCD CONVERTER	2.10
74189	64-BIT RAM (TRI-STATE)	3.65
74190	SYNCH DECADE- UP/DOWN COUNTER	1.43
74191	SYNCH BINARY UP/DOWN COUNTER	1.43
74192	DECADE UP/DOWN COUNTER (DM8560N)	1.43
74193	BINARY UP/DOWN COUNTER (DM8563N)	1.43
74194	4-BIT, BI-DIREC. UNIV. SHIFT REG	1.10
74195	4-BIT PARALLEL SHIFT REG	1.10
74196	PRESET DECADE COUNT	1.21
74198	PARA-IN, PARA-OUT 8-BIT SHIFT REG	2.20
74199	PARA-IN, PARA-OUT, 8-BIT SHIFT REG	2.20
74251	TRI STATE DM74151 (DM8121)	1.10
74284	4 x 4 MULT. (MOST SIG BIT) T.S.	4.95
74285	4 x 4 MULT. (LEAST SIG BIT) T.S.	4.95
74365	TRI STATE HEX BUFFER (DM8095)	.95
74366	TRI STATE HEX INVERT. (DM8096)	.95
74367	TRI STATE HEX BUFFER (4-2)	.95
74368	TRI STATE HEX INVERT (4-2)	.95

CMOS

CMOS

PART NO.	DESCRIPTION	PRICE
4000	DUAL 3-INPUT NOR GATE « INV.	$ .40
4001	QUAD 2-INPUT NOR GATE	.40
4002	DUAL 4-INPUT NOR GATE	.40
4006	18-BIT STATIC SHIFT REGISTER	1.42
4007	DUAL COMPLEMENTARY PAIR PLUS INV.	.40
4008	4-BIT FULL ADDER WITH PAR. CARRY	1.25
4011	QUAD 2-INPUT NAND GATE	.40
4012	DUAL 4-INPUT NAND GATE	.40
4013	DUAL D FLIP/FLOP	.72
4014	8-BIT STATIC SHIFT REGISTER	1.25
4015	DUAL 4-BIT STATIC REGISTER	1.47
4016	QUAD BILATERAL SWITCH	.72
4017	DECADE COUNTER/DIVIDER	1.25
4018	PRESETTABLE DIVIDE BY "N" COUNTER	1.14
4020	1-STAGE RIP CARRY BINARY COUNTER	1.47
4021	8-BIT STATIC SHIFT REGISTER	1.25
4022	DIVIDE BY 8 COUNTER/DIVIDER	1.25
4023	TRIPLE 3-INPUT NAND GATE	.40
4024	7-BIT BINARY COUNTER	1.06
4025	TRIPLE 3-INPUT NOR	.40
4027	DUAL J-K FLIP/FLOP	.72
4028	BCD-TO DECIMAL DECODER	1.02
4029	PRESETTABLE UP/DOWN COUNTER	1.42
4032	TRIPLE SER ADDER	2.19
4034	8-BIT SHIFT REGISTER	3.50
4035	4-BIT SHIFT REGISTER	1.86
4040	12-BIT BINARY RIPPLE COUNTER	1.47
4042	QUAD D LATCH	1.06
4043	QUAD TRI-STATE NOR R/S LATCH	.99
4044	QUAD TRI-STATE NAND R/S LATCH	.99
4046	PHASE LOCKED LOOP	1.57
4049	HEX INVERTING BUFFER	.72
4050	HEX BUFFER	.72
4051	SINGLE 8-CHANNEL MULTIPLEXER	1.30
4052	DIFFERENTIAL 4-CHANNEL MULTIPLEXER	1.30
4053	TRIPLE 2-CHANNEL MULTIPLEXER	1.30
4066	QUAD BILATERAL SWITCH	.80
4068	8-INPUT NAND GATE	.40
4069	HEX INVERTER	.40
4070	QUAD EXCLUSIVE OR GATE	.40

PART NO.	DESCRIPTION	PRICE
4071	BUFFERED QUAD 2-INPUT OR GATE	.40
4072	DUAL 4-INPUT OR GATE	.40
4073	TRIPLE 3-INPUT AND GATE	.40
4075	TRIPLE 3-INPUT OR GATE	.40
4076	TRI-STATE QUAD LATCH	1.57
4077	QUAD ECLSV NOR GATE	.40
4078	8-INPUT NOR GATE	.40
4081	BUFFERED QUAD 2-INPUT AND GATE	.40
4082	DUAL 4-INPUT GATE	.40
4093	QUAD 2-INPUT NAND SCHMITT TRIGGER	.78
4094	8-BIT BUS-COMP SHFT STR LATCH	3.01
4099	8-BIT ADDRESSABLE LATCH	1.73
4160	DEC CNTR ASYNC CLR	1.28
4161	BIN CNTR ASYNC CLR	1.28
4162	DEC CNTR SYNC CLR	1.28
4163	BIN CNTR SYNC CLR	1.28
4174	HEX D FLIP FLOP	1.28
4175	QUAD D FLIP FLOP	1.28
4194	4-BIT UNIV. SHIFT REG	1.42
4404	PULSE CODE MOD/DEMOD (CODEC)	27.36
4406	PULSE CODE MOD/DEMOD (CODEC)	34.27
4414	PCM FILTER	10.38
4408	BIN TO PHONE PLS CONV.	13.41
4409	BIN TO PHONE PLS CONV.	13.41
4410	2 OF 8 TONE ENCDR	15.11
4411	BIT RATE FEQ. GEN.	11.17
4412	UNIV. LW-SPEED MODEM	10.59
4415	QUAD PREC. TIMER/DRIVER	5.65
4419	2 OF 8 KYPD TO BIN ENCDR	7.79
4443	UP A/D CONVERTER	5.89
4457	R/C TRANSMITTER	4.50
4458	R/C TRANSMITTER	9.26
4469	ADDRESS ASYN RECEIVER/TRANSMITTER	13.37
4490	HEX CONTACT DE-BOUNCER	2.89
4495	HEX TO 7 SEG DECODER/DRIVER	2.70
4500	1-BIT CPU IND. CONT. UNIT	5.46
4501	TRIPLE GATE	.40
4502	STROBE HEX INV-BUFFER	1.73
4503	TRI-STATE HEX BUFFER	.84
4506	DUAL EXP AOI GATE	1.00
4506	DUAL 4-BIT LATCH	4.53

PART NO.	DESCRIPTION	PRICE
4510	BCD UP/DOWN COUNTER	1.47
4511	BCD-TO-SEVEN SEGMENT DECODER DRIVER	1.44
4512	8-CHANNEL DATA SELECTOR	1.42
4513	BCD-7 SEG LTCH/DEC/DRVR RIP-BL	1.91
4514	4-BIT LATCH 4 TO 16 LINE DECODER HI	2.91
4515	4-BIT LATCH 4 TO 16 LINE DECODER	2.91
4516	BINARY UP/DOWN COUNTER	1.59
4517	DUAL 64 BIT STATIC SHIFT REG	7.03
4518	DUAL BCD UP COUNTER	1.47
4519	4-BIT AND/OR SELECTOR	.80
4520	DUAL BINARY UP COUNTER	1.47
4521	24 STG FREQ DIVIDER	3.56
4522	DIVIDE-BY-N COUNTER (BCD)	1.18
4526	DIVIDE-BY-COUNTER (BINARY)	1.81
4527	BCD RATE MULTIPLIER	1.59
4528	DUAL MONOSTABLE MULTIVIBRATOR	1.81
4529	1DUAL 4-CHANNEL ANALOG DATA SELECTOR	1.96
4530	DUAL 5 IN. MAJORITY LOG-GATE	1.22
4532	8-BIT PRIORITY ENC.	3.01
4534	REAL TIME 5 DEC CNTR	9.16
4536	PROG. TIMER	4.86
4538	DUAL PREC. MONO-MLTVB	1.81
4539	DUAL 4-CHANNEL DATA SEL/MUX	1.44
4541	PROG OSC-TIMER	1.80
4543	BCD TO SEVEN SEGMENT DECODER (LCD)	2.63
4547	HI-CURRENT BCD/7 SEG DEC/DRVR	1.65
4551	QUAD 2 IN. ANALOG MUX	1.44
4554	3 DIGIT BCD CNTR	3.95
4556	DUAL BIN TO 1 OF 4 DEC (INV.)	1.15
4557	1 TO 64-BIT VARIABLE SHIFT REG	3.95
4558	BCD TO 7 SEG DCDR	1.77
4560	NBCD ADDER	3.80
4566	IND TIME BASE GEN	2.38
4568	PHASE COMPARATOR/PROG TIMER	4/23
4569	HIGH SPEED DUAL PROG. CTR	2.48
4582	LOOK AHEAD CARRY BLOCK	1.37
4583	DUAL SCHMITT TRIG	1.69
4584	EX RPL MM74C14N	.85
4585	4-BIT MAG COMP	1.80
4597	8-BIT BUS COMPAT CNTR-LATCH	3.72
4598	8-BIT BUS COMPAT ADDRS-LATCH	4.33
4599	8-BIT ADDRESSABLE LATCH	3.72
45100	4 x 4 CROSS POINT SW W/CONT MEM	3.85

LINEAR

PART NO.	DESCRIPTION	PRICE
LM301AN	IMPROVED 709 OP AMP	$ .49
LM307N	IMPROVED 741 OP AMP	.69
LM308N	PRECISION OP AMP LOW POWER	.82
LM311N	VOLTAGE COMPARATOR (DIP)	.70
LM311H	VOLTAGE COMPARATOR (TO-5)	1.42
LM324N	LOW POWER QUAD OR AMP	1.19
LM339N	LOW POWER & OFFSET VOLTAGE OP AMP	.80
LM348N	LOW POWER QUAD 741 OP AMP	1.31
LM358N	SINGLE ENDED LOW POWER DUAL OP AMP	.92
LM380N	2.5 WATT POWER AUDIO AMP	1.49
NE555V	TIMER I.C.	.55
NE555V/10	TIMER I.C. 10 PAK	4.50
NE556A	DUAL 555 TIMER	1.00
NE565A	PHASE LOCKED LOOP	1.49
LM710CN	HI SPEED VOLT COMP. (MC1710CP)	1.18
LM710CH	HI SPEED VOLT COMP. (MC1710CG)	1.20
LM711CN	DUAL V/COMP W/COMP OUTPUT (MC1711CP)	.64
LM711CH	DUAL VCOMP W/COMM OUTPUT (MC1711CG)	1.18
LM733CN	DIFF VIDEO AMP (MC1733CP)	1.00
LM741CN	G.P. OR AMP (MC1741CP)	.49

PART NO.	DESCRIPTION	PRICE
LM741CN/10	G.P. OP AMP (10 PAK) (MC1741CPI)	3.99
LM741CH	G.P. OP AMP (MC1741CG)	.79
LM747CN	DUAL 741 (MC1747CP2)	1.00
LM747CH	DUAL 741 (MC1747CG)	1.25
LM748CN	NON-COMP OP AMP (MC1748CP1)	.65
LM748CH	NON-COMP OP AMP (MC1748CG)	.90
MC1330AIP	LOW LEVEL VIDEO DET	1.50
MC1349P	HI GAIN VIDEO IF AMP	1.19
MC1350P	VIDEO IF AMP	.98
MC1352P	VIDEO IF AMP WITH AGC	1.39
MC1358P	SOUND IF AMP	1.30
MC1408L8	8-BIT D/A CONVERTER	4.69
MC1436CG	HI VOLT OP AMP	4.41
MC1439P1	HI SLEW RATE OP AMP	2.84
MC1445L	HI FREQ OP AMP	2.97
MC1456CP1	LINEAR OR AMP	1.20
MC1458CG	DUAL 741	.98
MC1458CP1	DUAL 741	.79
MC1488P	RS-232 DRIVER	1.05
MC1489P	RS-232 RECEIVER	1.05

PART NO.	DESCRIPTION	PRICE
MC1496P	BAL. MOD-DEMOD	1.31
MC3302P	L/PWR L/OFST QUAD COMP	.80
MC3310P	WIDE BAND AMP	.98
MC3340P	ELECTRONIC ATTENUATOR	1.50
MC3401P	QUAD OP AMP	.89
MC3403P	QUAD DIFF. OP AMP	1.29
MC3423P1	OVR/VOLT PROT CIRCUIT	1.31
LM3900N	QUAD OP AMP	.90
RC4136N	QUAD 741	1.79
MC4741CP	QUAD 741	1.40
IC8038N	FUNCTION GENERATOR	4.50
MC75450P	DUAL PERIPH. DRIVER (AND)	1.80
MC75451P	DUAL PERIPH. DRIVER (AND)	1.25
MC75452P	DUAL PERIPH. DRIVER (NAND)	1.25
MC75453P	DUAL PERIPH. DRIVER (OR)	1.25
MC75454P	DUAL PERIPH DRIVER (NOR)	1.25
MC75491P	QUAD LED SEGMENT DRIVER	.91
MC75492P	HEX LED DIGIT DRIVER	1.31

FET LINEAR

PART NO.	DESCRIPTION	PRICE
LF355N	JFET OR AMP L/CURRENT	$1.49
LF356N	JFET OP AMP WIDEBAND	1.49
LF357N	JFET OP AMP HI-SPEED	1.49

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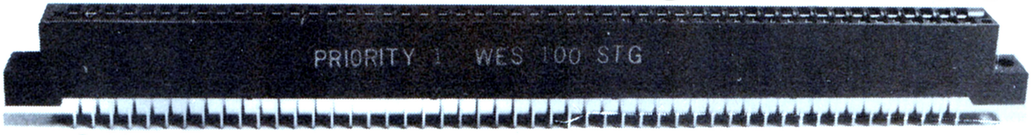
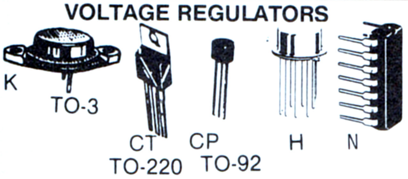


S-100 SOLDERTAIL & WIRE WRAP GOLD CARD EDGE CONNECTORS

- Reliable Copper 770 Alloy.
- Selective **GOLD** PLATED.
- Preloaded, Cantilever Spring Design.
- Glass-filled Thermoplastic Polyester
  Resists common cleaning solvents
  Chamfered card slot.
- .250" spaced row to row

PART NO.	DESCRIPTION	1-9	10-24	25-99	100-249
WES100STG	SOLDER TAIL	$3.50	$3.20	$2.80	$2.50
WES100WWG	WIRE WRAP	$4.00	$3.75	$3.50	$3.25

VOLTAGE REGULATORS



CASE STYLE

POSITIVE

PART NO.	OUTPUT		PRICE
LM78H05	5V	5A	$8.95
LM309K	5V	15A	$2.09
LM317K	1.2-37V	1.5A	$4.50
LM323K	5V	3A	$7.70
MC7806CK	6V	1.5A	$2.50
MC7808CK	8V	1.5A	$2.50
MC7812CK	12V	1.5A	$2.50
MC7815CK	15V	1.5A	$2.50
MC7818CK	18V	1.5A	$2.50
LM317T	1.2-37V	1.5A	$2.95
MC7805CT	5V	1.5A	$1.25
MC7806	6V	1.5A	$1.25
MC7808CT	8V	1.5A	$1.25
MC7812CT	12V	1.5A	$1.25
MC7815CT	15V	1.5A	$1.25
MC7818CT	18V	1.5A	$1.25
MC7824CT	24V	1.5A	$1.25
MC78L05CP	5V	.1A	$ .49
MC78L08CP	8V	.1A	$ .49
MC78L12CP	12V	.1A	$ .49
MC78L15CP	15V	.1A	$ .49
MC78L18CP	18V	.1A	$ .49
MC78L24CP	24V	.1A	$ .49

PART NO.	DESCRIPTION	PRICE
LM305H	2-5 - 40V Volt Reg.	$1.89
LM723CN	2-37V Volt Reg.	$ .59
LM723CH	2-37V Volt Reg.	$1.06
MC3423PI	Over/Volt Prot.	$1.31

NEGATIVE

PART NO.			PRICE
MC7905CK	5V	1.5A	$3.00
MC7906CK	6V	1.5A	$3.00
MC7908CK	8V	1.5A	$3.00
MC7912CK	12V	1.5A	$3.00
MC7915CK	15V	1.5A	$3.00
MC7918CK	18V	1.5A	$3.00
MC7924CK	24V	1.5A	$3.00
MC7905CT	5V	1.5A	$1.75
MC7906CT	6V	1.5A	$1.75
MC7908CT	8V	1.5A	$1.75
MC7912CT	12V	1.5A	$11.57
MC7912CT	12V	1.5A	$1.75
MC7915CT	15V	1.5A	$1.75
MC7918CT	18V	1.5A	$1.75
MC7924CT	24V	1.5A	$1.75
MC79L05CP	5V	.1A	$1.10
MC79L12CP	12V	.1A	$1.10
MC79L15CP	15V	.1A	$1.10
MC79L18CP	18V	.1A	$1.10
MC79L24CP	24V	.1A	$1.10

RECITFIER BRIDGES

	2 AMP	200V, 600V
MDA202	200V	$1.75
MDA206	600V	$2.00
	35 AMP	50V, 400V
MDA 3500	50V	$3.20
MDA 3504	400V	$3.50

SULLINS* GOLD PLATED EDGEBOARD CONNECTORS

E—Eyelet Gold S—Solder Tail Gold
W—Wire Wrap Gold

PART NO. APPLICATION	ROW SPACING	PRICE 1-9	10-24	25-99
.1" CONTACT CENTER CONNECTORS				
SUL1020E1	.140	$ 2.90	$ 2.55	$ 2.20
SUL1020W1	.200	2.80	2.45	2.15
SUL1326E1	.140	3.00	2.65	2.30
SUL2040E1	.140	4.40	3.85	3.30
SUL2040S1	.140	4.20	3.70	3.20
SUL2040W1	.200	4.40	3.85	3.30
SUL2244E1	.140	5.40	4.90	4.25
SUL2244S1	.140	5.20	4.70	4.20
SUL2244W1	.200	5.50	4.90	4.25
SUL2550E1	.140	6.10	5.40	4.70
SUL2550S1	.140	6.20	5.60	5.00
SUL2550W1	.200	6.00	5.35	4.65
SUL3060E1	.140	6.60	5.58	5.10
SUL3060S1	.140	6.35	5.60	4.90
SUL3060W1	.200	6.50	5.80	5.00
SUL3672E1	.140	8.00	7.10	6.10
SUL3672S1	.140	7.60	6.80	6.00
SUL3672W1	.200	7.95	7.00	6.10
SUL4080E1	.140	7.95	7.05	6.15
SUL4080S1	.140	7.90	6.95	6.05
SUL4080W1	.200	7.80	6.90	6.00
SUL4386E1	.140	8.80	7.90	7.00
SUL4386S1	.140	9.00	8.10	7.20
SUL4386W1	.200	9.60	8.60	7.60
SUL50100E1	.140	10.10	9.00	8.00
SUL50100S1	.140	9.60	8.60	7.60
SUL50100W1	.200	10.40	9.30	8.20
.125" CONTACT CENTER CONNECTOR				
SUL2856S2	.140	$ 5.80	$ 5.20	$ 4.40
SUL2856W2	.250	6.40	5.70	5.00
SUL3672W2	.250	6.80	6.10	5.40
SUL4080W2	.250	8.00	7.20	6.40
SULS100ALT	.140	7.95	7.20	6.40
SULS100SEG	.140	7.95	7.20	6.40
SULS100STG	.250	6.60	6.00	5.25
SULS100WWG	.250	7.00	6.25	5.40
SULCG1	IMSAI style Card Guides pkg. of 5			1.00
SULCG1/C	IMSAI style Card Guides pkg. of 100			15.00
156" CONTACT CENTER CONNECTORS				
SUL612E5	.140	$ 2.30	$ 2.00	$ 1.75
SUL612S5	.200	1.95	1.80	1.55
SUL1020E5	.140	2.00	1.77	1.53
SUL1224E5	.140	3.80	3.40	3.00
SUL1224S5	.200	3.80	3.40	3.00
SUL1530E5	.140	3.60	3.20	2.80
SUL1530S5	.140	3.50	3.05	2.65
SUL1530W5	.200	2.80	2.50	2.20
SUL1836E5	.140	4.25	3.75	3.25
SUL2244E5	.140	4.40	3.95	3.40
SUL2244S5	.140	4.95	4.35	3.80
SUL2244W5	.200	4.40	3.95	3.40
SUL3672E5	140	8.30	7.50	6.80
SUL3672W5	.200	8.40	7.40	6.45
SUL4386E5	.140	9.60	8.60	7.60
SUL4386S5	.140	9.20	8.15	7.00
SUL4386W5	.200	9.80	8.70	7.60

*** or equivalent**

FILAMENT TRANSFORMERS

High quality, low voltage
filament transformers.
Conservatively rated.

caltronics

PART NO.	PRIMARY	SEC.	RATING	SH.WT.	PRICE
CALT631	117V AC	6.3V	1 AMP	.5 lbs.	$3.39
CALT1261	117V AC	12.6V	1 AMP	.5 lbs.	$4.39
CALT126C05	117V AC	12.6VCT	500 MA	.5 lbs.	$3.39
CALT126C3	117V AC	12.6VCT	3 AMP	2 lbs.	$7.59
CALT241	117V AC	24V	1 AMP	1. lb.	$4.79

TEXAS INSTRUMENTS

GOLD PLATED EDGEBOARD CONNECTORS

GOLD PLATED EDGEBOARD CONNECTORS

RELIABLE COST-EFFICIENT CONTACT DESIGN:

- 50 (Wire Wrap) to 75 (solder tail) microinches gold inlay over a nickel diffusion barrier (minimum thickness).
- Copper-nickel-tin CA 726 Alloy.
- Bifurcated contact points.
- Preloaded cantilever spring design.
- Contacts are user removable.

RUGGED BODY

- Glass-filled thermoplastic polyester—Meets U.L. Flammability Classification 94V-0.—Resists common cleaning solvents.
- Solder standoff—Facilitates cleaning—Reduces solder wicking.
- Between contact polarization key (snaplock for .100" & .125" centers).
- Generous chamfered card slot.
- Molded contact identification.
- Location ridges (bottom) and raised dots (top) mark every fifth contact position.
- Entire connector design is U.L. Approved.

ABBREVIATIONS:
ST —Solder Tail Gold
WW —Wire Wrap Gold

421121-15 5358

TI EDGE CONNECTORS

.1" Contact Centers: ST - Soldertail GOLD: WW - Wire WrapGOLD

PART NO.	1-9	10-24	25-99	100-249
TIC1530-1 ST	$1.70	$1.50	$1.40	$1.20
TIC1530-1 WW	2.00	1.80	1.60	1.40
TIC1836-1 ST	2.00	1.80	1.60	1.40
TIC1836-1 WW	2.20	2.00	1.75	1.55
TIC2244-1 ST	2.40	2.15	1.95	1.70
TIC2244-1 WW	2.50	2.25	2.00	1.75
TIC2550-1 ST	2.60	2.35	2.05	1.80
TIC2250-1 WW	3.00	2.70	2.40	2.10
TIC3060-1 ST	2.95	2.60	2.30	1.90
TIC3060-1 ww	3.50	3.15	2.80	2.45
TIC3672-1 ST	3.30	2.95	2.60	2.30
TIC3672-1 WW	4.00	3.60	3.20	2.80
TIC4080-1 ST	3.60	3.25	2.85	2.40
TIC4080-1 WW	4.40	4.00	3.60	3.00
TIC4386-1 ST	3.90	3.50	3.10	2.60
TIC4386-1 WW	4.65	4.15	3.70	3.10
TIC50100-1 ST	4.50	4.05	3.60	3.00
TIC50100-1 WW	5.40	4.90	4.30	3.60

.125" Contact Centers: STG-Soldertail GOLD: WWG-Wire Wrap GOLD

PART NO.	1-9	10-24	25-99	100-249
TIC2244-2 ST	$2.30	$2.10	$1.85	$1.50
TIC2244-2 WW	2.80	2.50	2.25	1.95
TIC2856-2 ST	3.00	2.70	2.40	2.10
TIC2856-2 WW	3.60	3.25	2.90	2.50
TIC3060-2 ST	3.20	2.90	2.55	2.25
TIC3060-2 WW	3.60	3.25	2.90	2.50
TIC3672-2 ST	3.45	3.10	2.75	2.30
TIC3672-2 WW	4.20	3.80	3.40	2.95
TIC4080-2 ST	3.80	3.45	3.05	2.55
TIC4080-2 WW	4.45	4.00	3.55	2.95
TIC4488-2 ST	4.20	3.80	3.35	2.80
TIC4488-2 WW	5.00	4.50	4.00	3.50

We will be pleased
to give you a quotation
on your large quantity
requirements.

We are proud to feature Motorola, National, and other leading manufacturers of semiconductors. Exact part number of devices may vary depending on manufacturer.

CA, AK, HI, CALL (213) 709-5464

PRIORITY ONE ELECTRONICS

GENERAL INSTRUMENT LED NUMERIC DISPLAYS

(FORMERLY MONSANTO)

0.300" SEVEN SEGMENT DISPLAYS

STANDARD 14 PIN DUAL IN-LINE PACKAGING

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MA3620A	Orange	CA: LHD	510	F
MAN3640A	Orange	CC: RHD	510	F
MAN72A	Red	CA:LHD	125	A
MAN73A	Red	CA: Overflow #1	125	A
MAN74A	Red	CC: RHD	125	A

(Fits standard 14 PIN IC Socket)

- H.P. compatible common cathode displays
- Red, Yellow, Green, Orange and High Efficiency Red

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN58A	Green	CC:RHD	125	H
MAN3680A	Orange	CC: RHD	510	F
MAN78A	Red	CC: RHD	125	A
MAN88A	Yellow	CC: RHD	320	H
MAN3980A	Hi. Eff. Red	CC: RHD	320	D

HIGH EFFECIENCY RED

These devices have a red face and red segments.

- Fast switching—excellent for multiplexing.
- Lower power consumption.
- Bold solid segments that are highly legible.

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN3910A	Hi. Eff. Red	CC: RHD	320	D
MAN3910A				
MAN3920A	Hi. Eff. Red	CA: LHD	320	D
MAN3930A	Hi. Eff. Red	CA: Overflow #1	320	D
MAN3049A	Hi. Eff. Red	CC: RHD	320	D
MAN3980A	Hi. Eff. Red	CC: RHD	320	D

0.400" SEVEN SEGMENT DISPLAYS

STANDARD 14 PIN DUAL IN-LINE PACKAGING

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN4610A	Orange	CC: RHD	510	H
MAN4610A	Orange	CC: RHD	510	H
MAN4750A	Red	Universal (CA or CD) Overflow #1 RHD	200	B
MAN4710A	Red	CC: RHD	200	D

- H.P. compatible common cathode displays.
- Package size and lead configuration is the same as **MAN50A/3600A/70A/80A Series**

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN4580A	Green	CC: RHD	320	H
MAN4680A	Orange	CC: RHD	510	H
MAN4780A	Red	CC: RHD	200	B
MAN4880A	Yellow	CC: RHD	510	H
MAN4980A	Hi. Eff. Red	CC: RHD	320	E

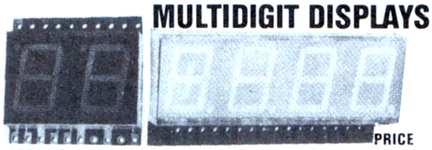
PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN4905A	Hi. Eff. Red	Universal (CA or CC) Overflow #1. RHD	320	E
MAN4910A	Hi. Eff. Red	CC: RHD	320	E
MAN4940A	Hi. Eff. Red	CC: RHD	320	E
MAN4980A	Hi. Eff. Red	CC: RHD	320	E

PRICE CODES

Letter	1-9	10-99	100-999	1K
A	$1.60	$1.45	$1.27	$1.06
B	2.10	1.80	1.60	1.35
C	2.20	2.00	1.75	1.45
D	2.40	2.20	1.95	1.75
E	2.65	2.40	2.15	1.75
F	2.85	2.50	2.25	1.95
G	3.00	2.70	2.40	2.10
H	3.05	2.80	2.40	2.05
I	3.15	2.80	2.50	2.35
J	3.60	3.30	2.80	2.45
K	4.20	3.85	3.35	3.10
L	4.60	4.25	3.65	3.35
M	4.95	4.50	4.20	3.80
N	9.95	8.95	8.40	7.60

*Luminous intensity measured @ 10mA (min.)

0.500" SEVEN SEGMENT MULTIDIGIT DISPLAYS



PART NO.	COLOR	DESCRIPTION	INT*	PRICE CODE
2 Digit Displays				
MAN56120	Orange	CA. direct drive	510	M
MAN56320	Orange	CC. direct drive	510	M
MAN58120	Yellow	CA. direct drive	510	M
MAN58320	Yellow	CC. direct drive	510	M
MAN59120	Hi. Eff. Red	CA. direct red	350	M
MAN59320	Hi. Eff. Red	CC. direct drive	350	M
4 Digit Displays				
MAN56240	Orange	CA. multiplexed	510	N
MAN56440	Orange	CC. multiplexed	510	N
MAN58240	Yellow	CA. multiplexed	510	N
MAN58440	Yellow	CC. multiplexed	510	N
MAN59240	Hi. Eff. Red	CA. multiplexed	350	N
MAN59440	Hi. Eff. Red	CC. multiplexed	250	N

0.560" SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY ORANGE

PART NO.	COLOR	DESCRIPTION	INT*	PRICE CODE
MAN6640	Orange	2 Digit: CC: RHD	510	L
MAN6680	Orange	Single Digit: CC: RHD	510	I

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN6710	**Red**	**2 Digit: CA: RHD**	**125**	J
MAN6730	Red	1½ Digit: CA: Overflow #1.8 RHD	125	J
MAN6740	Red	2 Digit: CC: RHD	125	J
MAN6780	Red	Single Digit: CC: RHD	125	C

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN6910	Hi. Eff. Red	2 Digit CA: RHD	320	K
MAN6930	Hi. Eff. Red	12 Digit CA: Overflow #1.8 RHD	320	K
MAN6940	Hi. Eff. Red	2 Digit CC: RHD	320	K
MAN6950	Hi. Eff. Red	1½ Digit CC: Overflow # **1.8 RHD**	320	K
MAN6960	Hi. Eff. Red	Single CA: RHD	320	K
MAN6980	Hi. Eff. Red	Single Digit CC: RHD	320	K

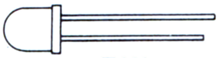
0.800" SEVEN SEGMENT DISPLAYS

HIGH PERFORMANCE, HIGH EFFICIENCY RED

- Red face and red segment for good ON/OFF contrast.

PART NO.	LED COLOR	DESCRIPTION	INT*	PRICE CODE
MAN8910	Hi. Eff. Red	CA: RHD	320	G
MAN8930	Hi. Eff. Red	CA: #1 Overflow RHD	320	G
MAN8940	Hi. Eff. Red	CC. RHD	320	G
MAN8950	Hi. Eff. Red	CC: #1 Overflow RHD	320	G

DISCRETE L.E.D.'S



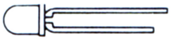
T1¾ .190 DIAMETER

PART NO.	COLOR	QTY.PER PK.	PRICE
LED-1R10	RED	10	$2.5u
LED-1R/C	RED	100	$20.00
LED-1Y10	YELLOW	10	$3.60
LED-1Y/C	YELLOW	100	$31.00
LED-1G10	GREEN	10	$3.60
LED-1G/C	GREEN	100	$31.00

T1¾ MOUNTING CLIP

Mounts T1¾ size LED's.
in .250 diameter hole in panels
up to .125 thick.

LED-CLIP	PK. 10	$1.25
LED-CLIP/C	PK. 100	$8.30



T1 .125 DIAMETER

LED-2R10	RED	10	$2.50
LED-2R/C	RED	100	$20.00
LED-2Y10	YELLOW	10	$3.60
LED-2Y/C	YELLOW	100	$31.00
LED-2G10	GREEN	10	$3.60
LED-2G/C	GREEN	100	$31.00

SIGNAL AND RECT. DIODES

	PIV	AMPS	APPLIC.	PACKAGE OF	/C 100
IN1183	50V	35A	RECT.	1/$2.26	$1.74
IN4001	50V	1A	RECT.	5/$1.00	$10.00
IN4003	200V	1A	RECT.	5/$1.00	$10.00
IN4005	600V	1A	RECT.	4/$1.00	$14.50
IN4007	1000V	1A	RECT.	4/$1.00	$18.50
IN4148	75V	10MA	SIG.	5/$1.00	$10.00
IN5400	50V	3A	RECT.	3/$1.19	$30.00
IN5402	200/V	3A	RECT.	3/$1.49	$40.00

ZENER DIODES

	V z	WATT	1T MA	PACKAGE OF	/C 100
IN4728A	3.3V	1W	76MA	4/$1.00	$16.00
IN4729A	3.6V	1W	69MA	4/$1.00	$16.00
IN4730A	3.9V	1W	64MA	4/$1.00	$16.00
IN4731A	4.3V	1W	58MA	4/$1.00	$16.00
IN4732A	4.7V	1W	53MA	4/$1.00	$16.00
IN4733A	5.1V	1W	49MA	4/$1.00	$16.00
IN4734A	5.6V	1W	45MA	4/$1.00	$16.00
IN4735A	6.2V	1W	41MA	4/$1.00	$16.00
IN4736A	6.8V	1W	37MA	4/$1.00	$16.00
IN4737A	7.5V	1W	34MA	4/$1.00	$16.00
IN4738A	8.2V	1W	31MA	4/$1.00	$16.00
IN4739A	9.1V	1W	28MA	4/$1.00	$16.00
IN4740A	10V	1W	25MA	4/$1.00	$16.00
IN4741A	11V	1W	23MA	4/$1.00	$16.00
IN4742A	12V	1W	21MA	4/$1.00	$16.00
IN4743A	13V	1W	19MA	4/$1.00	$16.00
IN4744A	15V	1W	17MA	4/$1.00	$16.00
IN4746A	18V	1W	14MA	4/$1.00	$16.00
IN4747A	20V	1W	12.5MA	4/$1.00	$16.00
IN4751A	30V	1W	8.5MA	4/$1.00	$16.00

ORDER BY QUANTITY OF PACKAGES ONLY

TRANSISTORS

	POLARITY	VDE	IC(MA)	HFE	MISC.	PKG. OF	/C 100
2N2219A	NPN	40V	800	200	300MHZ	2/$1.00	$40.00
SN2221A	NPN	30V	800	120	250MHZ	2/$1.00	$35.00
2N2222A	NPN	40V	800	300	300MHZ	3/$1.00	$27.00
2N2904A	PNP	60V	600	40	3WT	2/$1.00	$41.00
2N2906A	PNP	60V	600	40	1.8WT	2/$1.00	$40.00
2N2907A	PNP	60V	600	100	200MHZ	3/$1.00	$27.00
2N3053	NPN	40V	700	250	5WT	2/$1.40	$50.00
2N3054	NPN	55V	4A	100	75WT	$1.42	$23.00
2N3055	NPN	60V	15A	70	115WT	$ .98	$75.00
2N3904	NPN	40V	200	300	300MHZ	5/$1.00	$14.00
2N3906	PNP	40V	200	300	250MHZ	5/$1.00	$14.00
2N4400	NPN	40V	600	150	200MHZ	4/$1.00	$15.00
2N4401	NPN	40V	600	300	250MHZ	4/$1.00	$15.00
2N4402	PNP	40V	600	150	150MHZ	4/$1.00	$15.00
2N4403	PNP	40V	600	300	200MHZ	4/$1.00	$15.00
2N5400	PNP	120V	600	180	310MW	2/$1.00	$40.00
2N5401	PNP	150V	600	240	310MW	2/$1.00	$40.00
2N6028	PUT	40V	375MW	PROG	UJT	2/$1.00	$45.00
2N6282	NDL	60V	10A	1.8K	160W	$4.12	$355.00
2N6285	PDL	60V	10A	1.8K	160W	$4.95	$425.00
MPF102	NJFT	25V	10	VHF	AMP	2/$1.00	$45.00
MPF161	PJFT	40V	10	GEN	PRPS	2/$1.60	$60.00
MPS2222A	NPN	40V	800	300	300 MHZ	4/$1.00	$16.00
MPS2907	PNP	60V	600	100	200MHZ	4/$1.00	$16.00
MPSA13	NDL	30V	300	5K	200MHZ	2/$1.00	$30.00
MPSA63	PDL	30V	300	5K	200MHZ	2/$1.00	$30.00
MJE2955	PNP	60V	10A	90W	2MHZ	$2.98	$236.00
MJE2955T	PNP	60V	10A	75W	2 MHZ	$1.19	$95.00
MJE3055	NPN	60V	10A	90W	2 MHZ	$1.98	$160.00
MJE3055T	NPN	60V	10A	75W	2 MHZ	$ .98	$90.00
TIP29A	NPN	60V	3A	75	30W	2/$1.40	$55.00
TIP30A	PNP	60V	3A	75	30W	2/$1.60	$60.00
TIP31A	NPN	60V	5A	50	40W	2/$1.60	$65.00
TIP32A	PNP	60V	5A	50	40W	2/$1.60	$65.00
TIP41A	NPN	60V	10A	75	65W	$ .98	$85.00
TIP42C	PNP	60V	10A	75	65W	$1.49	$110.00
TIP48	NPN	300V	1A	150	40W	$1.10	$90.00
TIP49	NPN	350V	1A	150	40W	$1.20	$95.00
TIP120	NDL	60V	8A	1K	65W	$1.40	$115.00
TIP127	PDL	100V	8A	1K	65W	$1.98	$155.00
2N5060	SCR	30V	8A			2/$1.50	$60.00
C106B1	SCR	250V	4A			2/$1.00	$39.0
T2800B	TRIAC	200V	8A			$1.49	$120.00

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

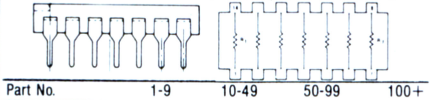
1 ONE

BECKMAN electro-products

RESISTOR NETWORKS

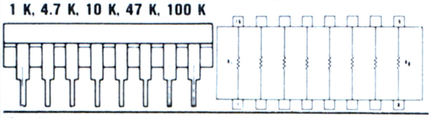
Beckman Resnet™ resistor networks are laser trimmed and 100% tested to assure the close tolerances and consistent top quality demanded by your customers. These networks all offer significant cost reduction in "on the board" costs and permit significant space savings over individual resistors. Various resistance values between 330Ω and 100KΩ are available.

MODEL 699-3F
Resistance Values Available (in ohms): 1 K, 10 K, 100 K



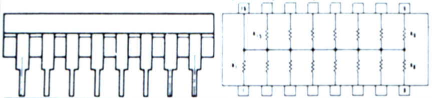
Part No.	1-9	10-49	50-99	100+
BCK696F102	3.00	2.49	2.22	1.94
BCK696F103	3.00	2.49	2.22	1.94
BCK696F104	3.00	2.49	2.22	1.94

MODEL 661-3
Resistance Values Available (in ohms):
1 K, 4.7 K, 10 K, 47 K, 100 K



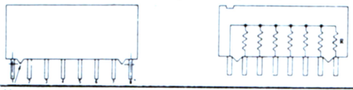
Part No.	1-9	10-49	50-99	100+
BCK6613102	1.60	1.40	1.20	.98
BCK6613472	1.60	1.40	1.20	.98
BCK6613103	1.60	1.40	1.20	.98
BCK6613473	1.60	1.40	1.20	.98
BCK6613104	1.60	1.40	1.20	.98

MODEL 661-1
Resistance Values Available (in ohms):
330, 470, 1 K, 2.2 K, 4.7 K, 10 K, 22 K, 47 K, 100 K



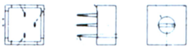
Part No.	1-9	10-49	50-99	100+
BCK6611331	1.60	1.40	1.20	.98
BCK6611471	1.60	1.40	1.20	.98
BCK6611102	1.60	1.40	1.20	.98
BCK6611222	1.60	1.40	1.20	.98
BCK6611472	1.60	1.40	1.20	.98
BCK6611103	1.60	1.40	1.20	.98
BCK6611223	1.60	1.40	1.20	.98
BCK6611473	1.60	1.40	1.20	.98
BCK6611104	1.60	1.40	1.20	.98

MODEL 784-1
Resistance Values Available (in ohms): 330, 1 K 10 K, 100 K



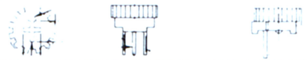
Part No.	1-9	10-49	50-99	100+
BCK7841331	1.60	1.40	1.20	.98
BCK7841102	1.60	1.40	1.20	.98
BCK7841103	1.60	1.40	1.20	.98
BCK7841104	1.60	1.40	1.20	.98

MODEL 72P - ½ watt (at 70 C)
Resistance Values Available (in ohms):
1 K, 5 K, 10 K, 20 K, 50 K, 100 K



Part No.	1-9	10-49	50-99	100+
BCK72P1K	1.98	1.60	1.40	1.20
BCK72P5K	1.98	1.60	1.40	1.20
BCK72P10K	1.98	1.60	1.40	1.20
BCK72P20K	1.98	1.60	1.40	1.20
BCK72P50K	1.98	1.60	1.40	1.20
BCK72P100K	1.98	1.60	1.40	1.20

MODEL 91A - ½ watt (at 40 C)
Resistance Values Available (in ohms):
1 K, 5 K, 10 K, 20 K, 50 K, 100 K



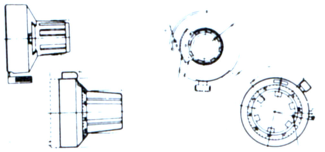
Part No.	1-9	10-49	50-99	100+
BCK91A1K	1.40	1.25	1.10	.95
BCK91A5K	1.40	1.25	1.10	.95
BCK91A10K	1.40	1.25	1.10	.95
BCK91A20K	1.40	1.25	1.10	.95
BCK91A50K	1.40	1.25	1.10	.95
BCK91A100K	1.40	1.25	1.10	.95

MODEL 93P - ½ watt (at 70 C)
Resistance Values Available (in ohms):
1 K, 5 K, 10 K, 20 K, 50 K, 100 K

Part No.	1-9	10-49	50-99	100+
BCK93P1K	4.50	4.10	3.70	3.30
BCK93P5K	4.50	4.10	3.70	3.30
BCK93P10K	4.50	4.10	3.70	3.30
BCK93P20K	4.50	4.10	3.70	3.30
BCK93P50K	4.50	4.10	3.70	3.30
BCK93P100K	4.50	4.10	3.70	3.30

TURNS-COUNTING DIALS

Designed for use with Beckman Helipot® precision potentiometers, these economical turns-counting dials are attractively styled and easy to read. The 10-turn model has a rugged black housing and knob with white numerals and the 15-turn model has a satin chrome finish and black numerals. Both models have a positive locking mechanism to prevent accidental setting changes.



Part No.	1-9	10-49	50-99	100+
BCK2626 10 Turn	10.95	9.00	8.00	7.50
BCK2606 15 Turn	15.00	13.50	12.00	10.50

CERMET TRIMMERS

The single-turn line is available in ⅜" and ½" sizes in both square and round varieties. They all offer simple screwdrive adjustability. Sealed for circuit board washing, they offer excellent performance under environmental extremes.

The multiturn line is available in either ⅜" square 18-turn, or ¾" rectangular 15-turn varieties. Choose either size or top screwdriver adjustment. A wiper idle clutch at both ends prevents damage. These rugged multiturns are sealed for board washing and offer excellent mechanical stability.

MODEL 89P - ¾ watt (at 25 C)
Resistance Values Available (in ohms):
1 K, 5 K, 10 K, 20 K, 50 K, 100 K

Part No.	1-9	10-49	50-99	100+
BCK89P1K	2.00	1.80	1.60	1.50
BCK89P5K	2.00	1.80	1.60	1.50
BCK89P10K	2.00	1.80	1.60	1.50
BCK89P20K	2.00	1.80	1.60	1.50
BCK89P50K	2.00	1.80	1.60	1.50
BCK89P100K	2.00	1.80	1.60	1.50

MODEL 89B
Panel Mounting Adapter for 89P

Part No.	1-9	10-49	50-99	100+
BCK89B	1.00	.90	.85	.80

MODEL 68W - ½ watt (at 70 C)
Resistance Values Available (in ohms):
1 K, 5 K, 10 K, 20 K, 50 K, 100 K

Part No.	1-9	10-49	50-99	100+
BCK68W1K	3.60	3.30	3.00	2.70
BCK68W5K	3.60	3.30	3.00	2.70
BCK68W10K	3.60	3.30	3.00	2.70
BCK68W20K	3.60	3.30	3.00	2.70
BCK68W50K	3.60	3.30	3.00	2.70
BCK68W100K	3.60	3.30	3.00	2.70

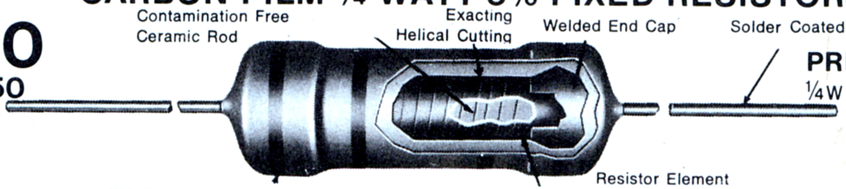
POTENTIOMETERS

Beckman's 10-turn ⅞" diameter wirewound Helipot® precision potentiometers are the recognized industry standards. They offer superior setting stability and the separate contact position guide increases coil life ad helps insure long term performance stability. Available in various resistance values, these dependable pots have guaranteed resistor tolerances of ±5% and shaft lives of one-half million to one million revolutions.

Part No.	1-9	10-49	50-99	100+
BCK72761K	13.95	12.00	10.00	9.50
BCK727610K	13.95	12.00	10.00	9.50
BCK727620K	13.95	12.00	10.00	9.50
BCK727650K	14.95	12.50	10.50	9.50
BCK7276103	14.95	12.50	10.50	9.50

CARBON FILM ¼ WATT 5% FIXED RESISTORS

$1.00
pkg. of 50
Shipping Wt. 1oz.


Contamination Free Ceramic Rod
Exacting Helical Cutting
Welded End Cap
Solder Coated Leadwire
Resistor Element (Deposited Pure Carbon Film)
EIA Standard Color Coding
Conformal Multi-Coating

PRD801 $2.45
¼w resistor lead bender

Part No.	Value	Part No.	Value	Part No.	Value	Part No.	Value	Part No.	Value	Part No.	Value
RCQ-100L	10 ohm	RCQ-101L	100 ohm	RCQ-102L	1.0 K	RCQ-103L	10 K	RCQ-104L	100 K	RCQ-105L	1.0 M
RCQ-110L	11 ohm	RCQ-111L	110 ohm	RCQ-112L	1.1 K	RCQ-113L	11 K	RCQ-114L	110 K	RCQ-115L	1.1 M
RCQ-120L	12 ohm	RCQ-121L	120 ohm	RCQ-122L	1.2 K	RCQ-123L	12 K	RCQ-124L	120 K	RCQ-125L	1.2 M
RCQ-130L	13 ohm	RCQ-131L	130 ohm	RCQ-132L	1.3 K	RCQ-133L	13 K	RCQ-134L	130 K	RCQ-135L	1.3 M
RCQ-150L	15 ohm	RCQ-151L	150 ohm	RCQ-152L	1.5 K	RCQ-153L	15 K	RCQ-154L	150 K	RCQ-155L	1.5 M
RCQ-160L	16 ohm	RCQ-161L	160 ohm	RCQ-162L	1.6 K	RCQ-163L	16 K	RCQ-164L	160 K	RCQ-165L	1.6 M
RCQ-180L	18 ohm	RCQ-181L	180 ohm	RCQ-182L	1.8 K	RCQ-183L	18 K	RCQ-184L	180 K	RCQ-185L	1.8 M
RCQ-200L	20 ohm	RCQ-201L	200 ohm	RCQ-202L	2.0 K	RCQ-203L	20 K	RCQ-204L	200 K	RCQ-205L	2.0 M
RCQ-220L	22 ohm	RCQ-221L	220 ohm	RCQ-222L	2.2 K	RCQ-223L	22 K	RCQ-224L	220 K	RCQ-225L	2.2 M
RCQ-240L	24 ohm	RCQ-241L	240 ohm	RCQ-242L	2.4 K	RCQ-243L	24 K	RCQ-244L	240 K	RCQ-245L	2.4 M
RCQ-270L	27 ohm	RCQ-271L	270 ohm	RCQ-272L	2.7 K	RCQ-273L	27 K	RCQ-274L	270 K	RCQ-275L	2.7 M
RCQ-300L	30 ohm	RCQ-301L	300 ohm	RCQ-302L	3.0 K	RCQ-303L	30 K	RCQ-304L	300 K	RCQ-305L	3.0 M
RCQ-330L	33 ohm	RCQ-331L	330 ohm	RCQ-332L	3.3 K	RCQ-333L	33 K	RCQ-334L	330 K	RCQ-335L	3.3 M
RCQ-360L	36 ohm	RCQ-361L	360 ohm	RCQ-362L	3.6 K	RCQ-363L	36 K	RCQ-364L	360 K	RCQ-365L	3.6 M
RCQ-390L	39 ohm	RCQ-391L	390 ohm	RCQ-392L	3.9 K	RCQ-393L	39 K	RCQ-394L	390 K	RCQ-395L	3.9 M
RCQ-430L	43 ohm	RCQ-431L	430 ohm	RCQ-432L	4.3 K	RCQ-433L	43 K	RCQ-434L	430 K	RCQ-435L	4.3 M
RCQ-470L	47 ohm	RCQ-471L	470 ohm	RCQ-472L	4.7 K	RCQ-473L	47 K	RCQ-474L	470 K	RCQ-475L	4.7 M
RCQ-510L	51 ohm	RCQ-511L	510 ohm	RCQ-512L	5.1 K	RCQ-513L	51 K	RCQ-514L	510 K	RCQ-515L	5.1 M
RCQ-560L	56 ohm	RCQ-561L	560 ohm	RCQ-562L	5.6 K	RCQ-563L	56 K	RCQ-564L	560 K	RCQ-565L	5.6 M
RCQ-620L	62 ohm	RCQ-621L	620 ohm	RCQ-622L	6.2 K	RCQ-623L	62 K	RCQ-624L	620 K	RCQ-625L	6.2 M
RCQ-680L	68 ohm	RCQ-681L	680 ohm	RCQ-682L	6.8 K	RCQ-683L	68 K	RCQ-684L	680 K	RCQ-685L	6.8 M
RCQ-750L	75 ohm	RCQ-751L	750 ohm	RCQ-752L	7.5 K	RCQ-753L	75 K	RCQ-754L	750 K	RCQ-755L	7.5 M
RCQ-820L	82 ohm	RCQ-821L	820 ohm	RCQ-822L	8.2 K	RCQ-823L	82 K	RCQ-824L	820 K	RCQ-825L	8.2 M
RCQ-910L	91 ohm	RCQ-911L	910 ohm	RCQ-912L	9.1 K	RCQ-913L	91 K	RCQ-914L	910 K	RCQ-915L	9.1 M
										RCQ-106L	10 M

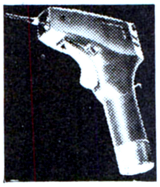
ORDER BY QUANTITY OF PACKAGES ONLY

IF YOU WISH:	QTY. ORDERED	PART NUMBER	UNIT	AMOUNT
150 PCS. of a 2.2 M Resistor	3	RCQ-225L	1.00	3.00

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

WIRE WRAPPING TOOLS AND WIRE

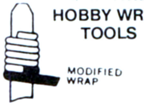


"HOBBY" WIRE WRAPPING TOOL BATTERY POWERED

For .025" (0.63mm) sq. post "MODIFIED" wrap, positive indexing anti-overwrapping device.

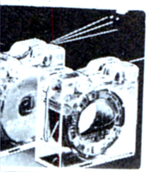
OKMBW2630	Tool	$ 21.95
OKMBC1	Batteries and Charger	$ 14.95
OKMBT30	Bit for AWG 30	$ 4.19
OKMBT2628	Bit for AWG 26-28	$ 8.49

Use "C" size NICAD Batteries, not included.



HOBBY WRAP TOOLS

OKMWSU30M	Modified Wrap	$8.49

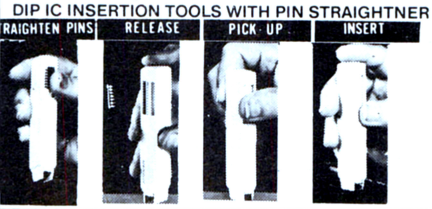


TRI-COLOR DISPENSER

- 3 Rolls of Wire in one dispenser.
- 3 Colors Blue, White, Red 50 ft. of each color
- AWG 30 (0.25mm) KYNAR™ Insulated Wire.
- Built-in Plunger cuts wire to desired length.
- Built-in Stripper strips 1" of insulation.
- Refillable (for refills, see below)

OKMWD30TRI	Tri-Color Dispenser	$8.49
OKMR30TRI	Replacement Rolls	$6.49

DIP IC INSERTION TOOLS WITH PIN STRAIGHTNER

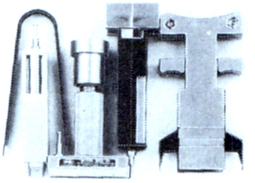


OKMINS1416	14-16 Pin Dip/IC Inserter	$3.95
OKMMOS1416	14-16 Pin, MOS CMOS Safe Inserter	$8.95
OKMMOS2428	24-28 Pin, MOS CMOS Safe Inserter	$8.95

36-40 PIN CMOS-SAFE IC INSERTION TOOL

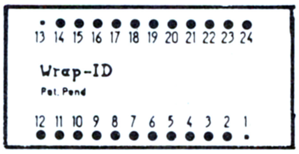
Unique new insertion tool. Also aligns bent-out pins. A twist of the handle compresses the pins to proper 600 inch spacing and locks the IC into the tool. Then simply place the tool on the socket and depress the plunger for instant and accurate insertion. Features heavy chrome plating through-out for reliable static dissipation. Includes terminal lug for attachment of ground strap. Ground Strap Not Included

OKMMOS-40	CMOS Safe Insertion Tool	$9.95



WK-7 IC INSERTION

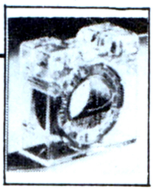
OKMWK 7	Complete IC Inserter/Extractor Kit	$34.95
	INDIVIDUAL COMPONENTS	
OKMMOS1416	14-16 Pin MOS CMOS Safe Inserter	$ 8.95
OKMMOS2428	24-28 Pin MOS CMOS Safe Inserter	$ 8.95
OKMMOS40	36-40 Pin MOS CMOS Safe Inserter	$ 9.95
OKMEX1	14-16 Pin Extractor Tool	$ 1.95
OKMEX2	24-40 Pin CMOS Safe Extractor Tool	$ 9.95



SOCKET WRAP — ID

Slipped onto socket before wrapping to identify pins

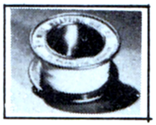
PART NO.	PKG. QTY.	PRICE	PART NO.	PKG. QTY.	PRICE
OKM14ID	10	$1.69	OKM14ID100	100	$8.95
OKM16ID	10	1.69	OKM16ID100	100	8.95
OKM18ID	10	1.69	OKM18ID50	50	8.95
OKM20ID	5	1.69	OKM20ID50	50	8.95
OKM24ID	5	1.69	OKM24ID50	50	9.95
OKM28ID	5	1.69	OKM2850	50	9.95
OKM40ID	5	1.69	OKM4025	25	8.95



WIRE DISPENSER

- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Built-in Plunger cuts wire to desired length.
- Built-in Stripper strips 1" of insulation.
- Refillable (For refills, see below)

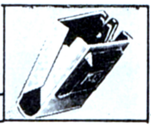
OKMWD30B	Blue Wire	$5.49
OKMWD30Y	Yellow Wire	5.49
OKMWD30W	White Wire	5.49
OKMWD30R	Red Wire	5.49



DISPENSER REPLACEMENT ROLLS

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire 50 ft. roll, silver plated, solid conductor, easy stripping.

OKMR30B50	30-AWG Blue 50 ft. roll	$3.49
OKMR30Y50	30-AWG Yellow 50 ft. roll	3.49
OKMR30W50	30-AWG White 50 ft. roll	3.49
OKMR30R50	30-AWG Red 50 ft. roll	3.49

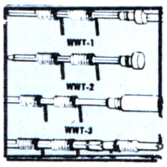


"CLIP AND STRIP" TOOL

A unique new design for stripping 1" insulation from 30AWG wire. Insert wire, squeeze tool closed to cut off excess wire, pull wire through stripping slot to remove insulation. Handy pocket size only 1¾" x 1" x ⅝". Shipping Weight 4 oz.

The above cut and strip tool is not applicable for Mylene or Teflon insulation.

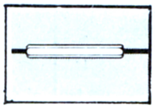
OKMCAS130	Clip and Strip	$2.49



TERMINALS

- .025" (0.63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated. 25 per Pkg.

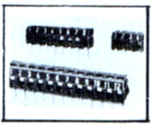
OKMWWT1	Slotted Terminal	$6.29
OKMWWT2	Single Sided Terminal	3.79
OKMWWT3	IC Socket Terminal	6.29
OKMWWT4	DBL. Sided Terminal	2.19



TERMINAL INSERTING TOOL

For inserting WWT-1, WWT-2, WWT-3, and WWT-4 Terminals into .040" (1.0mm) Dia. Holes.

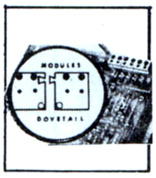
OKMINS1	Inserting Tool	$2.98



P.C.B. TERMINAL STRIPS

The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1.8-0.24mm). Pins are solder plated copper, .042 inch (1mm) diameter on 200 inch (5mm) cneters.

OKMTS4	4-Pole	$1.98
OKMTS8	8-Pole	2.98
OKMTS12	12-Pole	3.98



MODULAR TERMINAL STRIPS

For versatile, economical connections especially in bread-boarding and short runs. Tow circuit modules are dovetailed togehter in various combinations to form printed circuit board terminals with the deisired number of circuits. Making stable, low-resistance connections with only a screwdriver, the space-saving terminals take conductors from 26 through 16 AWG conforming to 20 inch (5.08mm) hole spacing on boards up to 126 inch (3.20mm) thick.

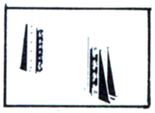
OKMTS6MD	2-Pole	$2.19

PC CARD GUIDES

TR-1 consists of 2 guides precision molded with unique spring finger action that dampens shock and vibration, yet permits smooth insertion or extraction. Guides accommodate any card thickness from .040-.100 inches.

Quantity — one Pair (2 pcs)

OKMTR1	Card Guides	$2.29



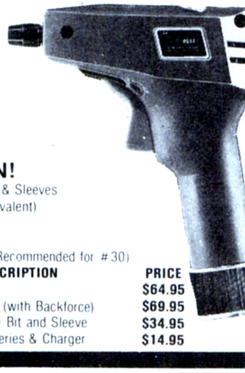
PC CARD GUIDES & BRACKETS

TRS-2 kit includes 2 TR-1 guides plus 2 mounting brakcets. Support brackets feature unique stabilizing post that permits secure mounting with only 1 screw.

Quantity — One Set (4 pcs)

OKMTRS2	Guides & Brackets	$4.49

BW928 INDUSTRIAL WRAPPING TOOL



GREAT FOR PRODUCTION!

- Accepts Industrial Bits & Sleeves (Gardner Denver or equivalent)
- Auto-Indexing
- Modified Wrap
- Back-Force available (Recommended for #30)

PART NO.	DESCRIPTION	PRICE
OKMBW928	Tool	$64.95
OKMBW928BF	Tool (with Backforce)	$69.95
OKMBT301	#30 Bit and Sleeve	$34.95
OKMBC1	Batteries & Charger	$14.95

NEW!

WHY CUT?
WHY STRIP?
WHY SLIT?

WHY NOT ... ONE

JUST WRAP

WIRE WRAPPING TOOL

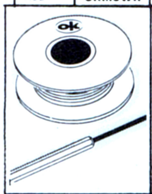
$15.95

- AWG 30 Wire
- .025" Square Posts
- Daisy Chain or Point To Point
- No Stripping or Slitting Required ...JUST WRAP™...
- Built in Cut Off
- Easy Loading of Wire
- Available Wire Colors: Blue, White, Red & Yellow

U.S.A.
Foreign
Patents
Pending

Just Wrap Tool With One 50 Ft. Roll of Wire

COLOR	PART NO.	LIST
Blue	OKMJWB	$15.95
White	OKMJWW	$15.95
Yellow	OKMJWY	$15.95
Red	OKMJWR	$15.95



JUST WRAP REPLACEMENT ROLLS

OKMRJWB	Blue Wire	50 ft. roll	3.49
OKMRJWW	White Wire	50 ft. roll	3.49
OKMRJWY	Yellow Wire	50 ft. roll	3.49
OKMRJWR	Red Wire	50 ft. roll	3.49

UNWRAP TOOL FOR JUST WRAP

OKMJUW1	Unwrapping Tool	3.79

JUST WRAP KIT

CONTAINS:

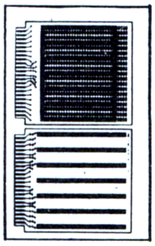
- JUST WRAP Tool
- Roll of Blue Wire, 50 ft.
- Roll of White Wire, 50 ft.
- Roll of Yellow Wire, 50 ft.
- Roll of Red Wire, 50 ft.
- Unwrapping Tool

OKMJWK6	JUST WRAP Kit	$26.95

VACUUM VISE

Unique vacuum based light duty vise for precision handling of small components and assemblies. Rugged ABS construction 1½" (38mm) wide jaws, 1¼" (32mm) travel for maximum versatility. Also features screw lugs for permanent installation. (mounting screws included)

OKMVV1	Vacuum Vise	$3.79



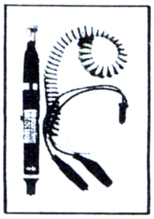
PC BOARD

The 4 x 45 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector with contacts on standard 156 spacing Edge contacts are non-dedicated for maximum flexability.

The board contains a matrix of .040 in diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 6.40 pins as well as discrete components. Typical density is 18 of 14 Pin DIPs Components may be soldered directly to the board or immediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board in addition the component side contains 14 individual buses running the full length of the board for complete wiring flexibility. These buses enable access irom edge contacts to distant components. These buses can also serve to augment the voltage or ground buses and may be cut to length to particular applications.

OKMHPCB1	Hobby Board	$5.49



PRB-1 DIGITAL LOGIC PROBE

Compatible with all logic families using a 4 to 15V power supply. Thresholds automatically programmed. Visual indication of logic levels to show high, low, bad level or open circuit logic pulses.

- 10 nsec. pulse responses
- 120K input impedance
- Automatic resetting memory
- Includes tip with protective cap & coiled cord

PSL-1 LOGIC PULSAR

Superimposes a pulse train (20 pps) or a single pulse onto the circuit node under test without unsoldering IC's.

- Automatic polarity sensing
- 2 us pulse width
- Finger tip push button actuated
- Includes tip with protective cap & coiled cord

OKMPRB1	Digital Logic Probe	$39.95
OKMPLS1	Logic Pulser	54.95

DESOLDERING PUMP

Easy one hand operation. Rugged all metal construction Replaceable TEFLON Tip. Self Cleaning on each stroke Suction precisely regulated for reliable desoldering without damage to delicate circuitry.

PART NO.	DESCRIPTION	PRICE
OKMP1	Desoldering Pump	$11.95

ORDER TOLL FREE (800) 423-5922

PRIORITY ONE ELECTRONICS

WINCHESTER ELECTRONICS

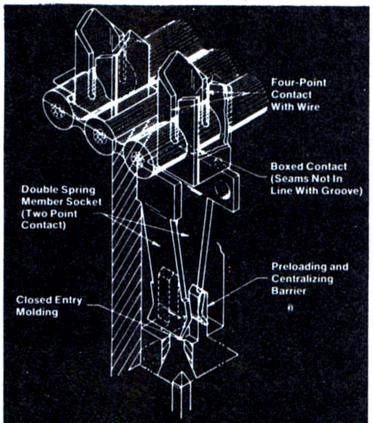
Litton

Contacts:

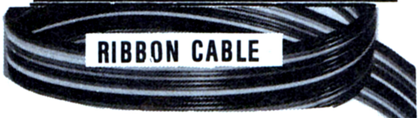
1. Box-shaped termination ends with parallel, double tines, increases wire holding strength.
2. Side-seamed, *not* center-seamed, termination ends remain closed when wire is terminated.
3. Strengthening rib has been added to contacts on all standard and low-profile dips; allows pins to bend without breaking.
4. Socket connector contacts contain *double* opposing spring fingers to insure tightest connection.
5. Unique socket alignment feature permits lower mating force; interior fingers are preloaded toward incoming pins.
6. Gold contacts.

Insulators:

1. Low-cost, all-plastic insulators on all Flex-Com connectors, including new D-Subminiature.
2. D-Subminiature connector uses standard 50-mil cable, no special cable or tooling required.
3. One-step assembly features a two-stage latch, saves time, increases accuracy. All connectors (except Standard Dip) are shipped with insulator body and cover already joined, held open to first position of its two-stage latch. Cable is simply inserted between connector halves and latch snaps shut to second stage during termination procedure.
4. Metal latch standard on low-profile dip, edgecard and socket connectors.
5. Cavities in cover plate prevent contact splaying during termination.
6. Cover plate probe openings for easy systems checks.


Four-Point Contact With Wire
Boxed Contact (Seams Not In Line With Groove)
Double Spring Member Socket (Two Point Contact)
Preloading and Centralizing Barrier
Closed Entry Molding

IDC Socket Contact



RIBBON CABLE

COLOR CODED LAMINATED CABLE FOR INSULATION DISPLACEMENT 28 GAUGE, 7 STRAND

PART NO.	NO. OF CONDUCTORS	PRICE PER SPOOL 10 Ft.	100 Ft.
IDC-09CC*	9	3.80	30.00
IDC-14CC*	14	4.75	40.00
IDC-16CC*	16	5.50	45.00
IDC-20CC*	20	7.00	60.00
IDC-25CC*	25	8.50	72.00
IDC-26CC*	26	8.50	72.00
IDC-34CC*	34	11.00	100.00
IDC-40CC*	40	13.00	115.00
IDC-50CC*	50	16.00	145.00

GRAY LAMINATED CABLE FOR INSULATION DISPLACEMENT 28 Gauge 7 Strand

PART NO.	NO. OF CONDUCTORS	PRICE PER SPOOL 10 Ft.	100 Ft.
IDC-09GY*	9	2.50	18.05
IDC-14GY*	14	3.50	28.00
IDC-16GY*	16	4.00	32.00
IDC-20GY*	20	4.80	40.00
IDC-25GY*	25	6.00	50.00
IDC-26GY*	26	6.00	50.00
IDC-34GY*	34	8.30	66.00
IDC-40GY*	40	10.00	77.00
IDC-50GY*	50	12.00	95.00

*Add "/C" to Part No. for 100 Ft. spool.

HEADER CONNECTOR EJECTOR

The IDCEJ provides an ejector and positive lock for socket connectors when used with any of the header connectors listed. Easy installation and low cost provide easy extraction, when desired, for your IDC socket interconnects. Order 2 for each connector.

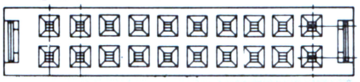
PART NO.	QTY.	PRICE
IDCEJ5	pkg 5	$ 1.00
IDCEJC	pkg 100	$10.00

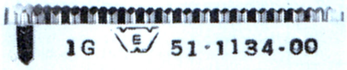
FLEX-COM

EDGECARD CONNECTOR

PART NO.	NO. OF PINS	1-9	PRICE 10-24	25-99	100-249
IDC20CE	10/20	4.35	4.00	3.30	3.00
IDC26CE	13/26	5.00	4.50	5.75	3.25
IDC34CE	17/34	6.00	5.40	4.50	4.00
IDC40CE	20/40	6.90	6.20	5.30	4.80
IDC50CE	25/50	7.25	6.80	5.90	5.30

SOCKET CONNECTOR



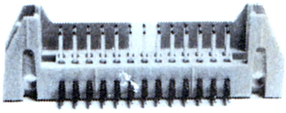


PART NO.	NO. OF PINS	1-9	PRICE 10-24	25-99	100-249
IDC20SKT	10/20	2.75	2.50	1.85	1.70
IDC26SKT	13/26	3.50	3.20	2.40	2.20
IDC34SKT	17/34	4.50	4.20	3.10	2.90
IDC40SKT	20/40	5.40	5.00	3.65	3.30
IDC50SKT	25/50	6.50	6.00	4.60	4.20

PLUG CONNECTORS

PART NO.	NO. OF PINS	1-9	PRICE 10-24	25-99	100-249
IDC682010	10/20	5.50	5.20	4.80	4.40
IDC682610	13/26	6.25	5.65	5.00	4.50
IDC683410	17/34	7.00	6.25	5.70	5.00
IDC684010	20/40	7.50	6.75	6.00	5.25
IDC685010	25/50	8.50	7.50	6.50	6.00

HEADER CONNECTOR

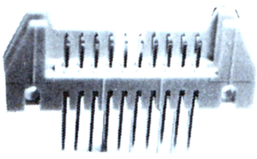


RIGHT ANGLE SOLDERTAIL GOLD HEADER

PART NO.	1-9	10-24	25-99	100-249
IDCRAH 20ST	1.90	1.60	1.20	1.00
IDCRAH 26ST	2.25	2.00	1.55	1.30
IDCRAH 34ST	2.95	2.60	2.05	1.70
IDCRAH 40ST	3.60	3.00	2.40	2.10
IDCRAH 50ST	4.30	3.60	3.00	2.55

RIGHT ANGLE WIRE WRAP GOLD HEADER

PART NO.	1-9	10-24	25-99	100-249
IDCRAH 20WW	4.15	3.60	2.75	2.40
IDCRAH 26WW	5.30	4.30	3.60	3.10
IDCRAH 34WW	5.95	5.00	4.15	3.70
IDCRAH 40WW	7.00	6.00	4.90	4.30
IDCRAH 50WW	7.95	6.80	6.15	5.20



STRAIGHT SOLDERTAIL GOLD HEADER

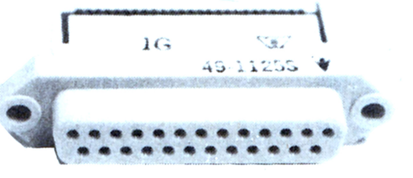
PART NO.	NO. PINS	1-9	10-24	25-99	100-249
IDCSTH20ST	10/20	1.85	1.55	1.20	1.00
IDCSTH26ST	13/26	2.20	1.95	1.55	1.30
IDCSTH34ST	17/34	2.90	2.55	2.05	1.70
IDCSTH40ST	20/40	3.55	2.95	2.40	2.00
IDCSTH50ST	25/50	4.25	3.55	3.00	2.50

STRAIGHT WIRE WRAP GOLD HEADER

PART NO.	NO. PINS	1-9	10-24	25-99	100-249
IDCSTH20WW	10/20	4.20	3.55	2.75	2.50
IDCSTH26WW	13/26	5.25	4.25	3.60	3.20
IDCSTH34WW	17/34	5.90	4.95	4.15	3.60
IDCSTH40WW	20/40	6.95	5.95	4.90	4.40
IDCSTH50WW	25/50	7.90	6.75	6.15	5.30

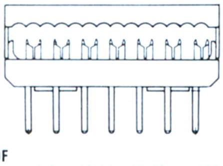
IDC System

D-SUBMINIATURE CONNECTOR



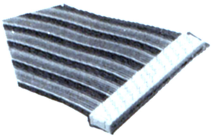
P = Plug-Male
S = Socket-Female
C = Cover-Hood

PART NO.	NO. OF PINS	1-9	10-24	25-99	100-249
IDCDE9P	9	4.20	4.00	3.60	3.20
IDCDE9S	9	4.50	4.20	3.80	3.40
IDCDE9C	9	1.25	1.10	1.00	.95
IDCDA15P	15	4.35	4.20	3.75	3.40
IDCDA15S	15	5.00	4.85	4.35	3.90
IDCDA15C	15	1.40	1.25	1.10	.95
IDCDB 25P	25	6.25	6.00	5.20	4.70
IDCDB 25S	25	6.60	6.35	5.60	5.00
IDCDB 25C	25	1.60	1.50	1.35	1.20
IDCDC37P	37	8.80	8.00	7.20	6.40
IDCDC37S	37	11.00	10.25	9.20	8.20
IDCDC37C	37	2.25	2.00	1.80	1.60



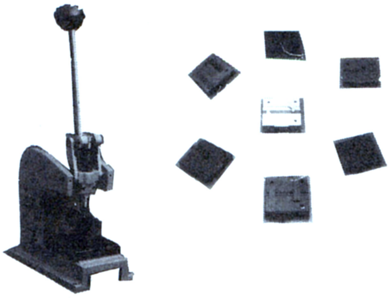
DIP PLUGS

PART NO.	NO. OF PINS	1-9	10-24	25-99	100-249
IDC14DP	14	1.50	1.40	1.25	1.10
IDC16DP	16	1.70	1.60	1.45	1.30
IDC24DP	24	2.50	2.20	2.00	1.80



TRANSITION CONNECTOR

PART NO.	NO. OF PINS	1-9	PRICE 10-24	25-99	100-249
IDCTRNS10	10	2.00	1.60	1.10	1.00
IDCTRNS16	16	2.20	1.80	1.30	1.10
IDCTRNS20	20	2.50	2.00	1.40	1.25
IDCTRNS26	26	3.00	2.40	1.80	1.50
IDCTRNS34	34	4.00	3.10	2.20	2.00
IDCTRNS40	40	4.50	3.50	2.50	2.25
IDCTRNS50	50	5.50	4.40	3.10	2.50



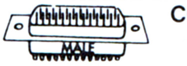
INSTALLATION/ASSEMBLY TOOLS

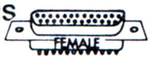
IDC1080	Arbor Press with Ram for all connectors *except* D-Subminiature order platens below. 12 LBS.	$180.00
IDC013031	Platen & Ram for D-Subminiature Connectors	$ 50.00
IDC1083	Platen for Edgecard Connector	$ 35.00
IDC10811	Platen for Socket Connector	$ 35.00
IDC1096	Platen for 24 Pin Dip Plug only	$ 35.00
IDC10871	Platen for 14 & 16 Pin Dip Plug only	$ 35.00
IDC1084	Platen for Transition Connector	$ 35.00
IDC1070550	Platen for Plug Connector	$ 35.00

CALL FOR QUANTITY PRICING

PRIORITY ONE ELECTRONICS

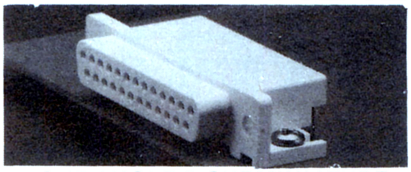
RS232 and "D" SUB-MINIATURE CONNECTORS





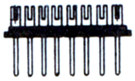
P = Plug, Male Type - S = Socket, Female Type - C = Cover, Hood

PART NO.	DESCRIPTION	PRICE 1-9	10-24	25-99
CNDDE9P	9 Pin Male	$ 2.10	$ 1.90	$ 1.70
CNDDE9S	9 Pin Female	$ 2.70	$ 2.40	$ 2.10
CNDDE9C	9 Pin Cover	$ 1.50	$ 1.25	$ 1.10
CNDDA15P	15 Pin Male	$ 2.75	$ 2.45	$ 2.15
CNDDA15S	15 Pin Female	$ 3.95	$ 3.60	$ 3.20
CNDDA15C	15 Pin Cover	$ 1.50	$ 1.30	$ 1.10
CNDDB25P	25 Pin Male	$ 3.00	$ 2.75	$ 2.25
CNDDB25S	**25 Pin Female**	$ 4.00	$ 3.75	$ 3.00
CNDDB51212	**1 Pc. Grey Hood**	$ 1.60	$ 1.45	$ 1.30
CNDP25H	**2 Pc. Grey Hood**	$ 1.50	$ 1.25	$ 1.10
CNDDB51226	**2 Pc. Black Hood**	$ 1.90	$ 1.65	$ 1.45
CNDDC37P	37 Pin Male	$ 5.80	$ 5.10	$ 4.45
CNDDC37S	37 Pin Female	$ 8.70	$ 7.70	$ 6.70
CNDDC37C	37 Pin Cover	$ 1.80	$ 1.55	$ 1.30
CNDDD50P	50 Pin Male	$ 8.75	$ 7.75	$ 6.70
CNDDD50S	50 Pin Female	$11.65	$10.25	$ 8.90
CNDDD50S	50 Pin Cover	$ 2.00	$ 1.80	$ 1.60
CNDD20418	Hardware Set 2 Pr	$ 1.00	$ 0.80	$ 0.70
	RS232, DB25P, EIA			
CNDRS2328F	Class 1 Cable 8 Con. 8 Ft.	$19.95	$17.95	$15.95
CND573036	Cent. 700 Series/ Epson Printer Conn.	$ 9.00	$ 7.50	$ 6.00
IDC5730860	IDC Version of Above	$ 9.95	$ 9.00	$ 8.00



RIGHT ANGLE D-SUBMINIATURE CONNECTOR

PART NO.	NO. OF PINS	1-9	10-24	25-99	100-249
IDCRADE9P	9	4.50	4.10	3.70	3.30
IDCRADE9S	9	4.70	4.30	3.90	3.50
IDCRADA15P	15	4.80	4.50	4.20	3.90
IDCRADA15S	15	5.10	4.90	4.70	4.40
IDCRADB25P	25	6.30	6.00	5.25	4.75
IDCRADB25S	25	6.75	6.40	5.50	5.00
IDCRADC37P	37	9.00	8.10	7.30	6.50
IDCRADC37S	37	11.50	10.60	9.50	8.50



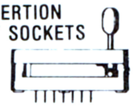
DIP PLUGS

For Component Mounting or Interconnect Cables.

PART NO.	PINS	PRICE 1-9	10-24	25-99	100-249
KNX08DP	8	.50	.45	.43	.40
KNX14DP	14	.65	.60	.58	.55
KNX16DP	16	.70	.65	.62	.58
KNX24DP	24	1.15	1.05	.90	.95
KNX400P	40	2.00	1.80	1.70	1.60

ZERO INSERTION FORCE TEST SOCKETS

TEXTOOL



	1-9	10-24	25-99
ZIP16DIP	$ 5.75	$ 5.60	$ 5.20
ZIP24DIP	$ 7.75	$ 7.50	$ 7.20
ZIP40DIP	$10.50	$10.10	$ 9.75

SIBMINIATURE TOGGLE SWITCHES

SPDT STANDARD TOGGLE		1-9	10-24	25-99
CALST11	(ON-NONE-ON)	$2.60	$2.40	$2.20
CALST12	(ON-OFF-ON)	$2.80	$2.50	$2.30
CALST13	(MOM ON-OFF-MON-ON)	$2.80	$2.50	$2.30
CALST14	(ON-OFF-MON ON)	$2.80	$2.50	$2.30
CALST15	(ON-NONE-MON ON)	$2.80	$2.50	$2.30

6 Amps 25 VAC
7 Amps 30 VDC

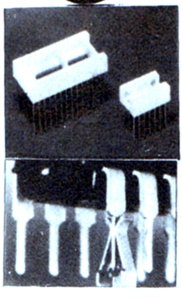
DPDT STANDARD TOGGLE		1-9	10-24	25-99
CALST21	(ON-NONE-ON)	$3.50	$3.25	$3.10
CALST22	(ON-OFF-ON)	$3.80	$3.50	$3.25
CALST23	MON ON-OFF-MOM-ON)	$3.80	$3.50	$3.25
CALST24	(ON-OFF-MOM ON)	$3.95	$3.60	$3.40
CALST25	(ON-NONE-MOM ON)	$3.95	$3.60	$3.40
CALST26	(ON-ON-ON)	$3.95	$3.60	$3.40

22GA. TWISTED PAIR CABLE
PRICE PER LENGTH

PART NO.	NO. OF PAIRS	25 ft.	100 ft.	500 ft.	PER 100
CON5151*	1	$ 3.00	$ 8.75	$38.00	2 lbs.
CON5153*	3	$ 8.00	$25.00	$110.0	3 lbs.
CON5155'	5	$13.00	$40.00	$175.0	5 lbs.
CON5165*	15	$36.75	$115.0	$490.0	14 lbs.

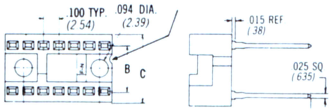
*Add "/C" for 100 ft. or "D" for 500 ft. spools

ROBINSON NUGENT, INC.

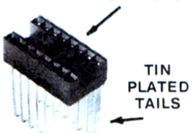


ICN SERIES GOLD 3 LEVEL WIRE WRAP SOCKETS

- 10 μ in GOLD Plated Pins
- Deep Chamfered Closed Entry Contacts
- RN Side Wipe Contact Design
- Phosphor Bronze Contact Material
- Terminal Barbs Allow Self-lock into PC Board
- Rugged Socket Body Design
- Deep Chamfered Closed Entry Contacts



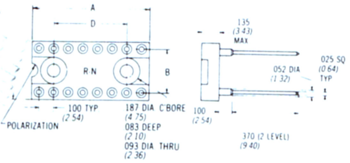
PART NO.	PINS	PRICE 1-9	10-24	25-99	100-249	250-999
RNS08WWG	8	.60	.55	.49	.45	.41
RNS14WWG	14	.75	.70	.65	.55	.48
RNS16WWG	16	.85	.75	.70	.60	.52
RNS18WWG	18	1.00	.90	.80	.75	.71
RNS20WWG	20	1.20	1.05	.96	.91	.87
RNS22WWG	22	1.35	1.25	1.15	1.05	.99
RNS24WWG	24	1.35	1.25	1.15	1.05	.99
RNS28WWG	28	1.70	1.55	1.40	1.34	1.25
RNS40WWG	40	2.20	2.05	1.85	1.60	1.50



NEW!
SELECTIVE PLATED PINS THAT WILL SAVE YOU MONEY BY HAVING GOLD ONLY WHERE IT COUNTS!
Same as above except pins are selectively plated.

PART NO.	PINS	PRICE 1-9	10-24	25-99	100-24	250-99
RNS08TWW	8	.55	.50	.45	.41	.37
RNS14TWW	14	.65	.55	.50	.47	.44
RNS16TWW	16	.75	.65	.52	.51	.46
RNS18TWW	18	.90	.79	.75	.70	.65
RNS20TWW	20	1.10	.95	.91	.87	.82
RNS22TWW	22	1.25	1.15	1.05	.94	.89
RNS24TWW	24	1.25	1.15	1.05	.96	.89
RNS28TWW	28	1.50	1.45	1.35	1.25	1.15
RNS40TWW	40	2.00	1.80	1.60	1.40	1.30

ICA SERIES HIGH RELIABILITY SOCKETS

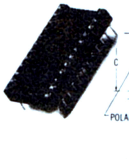


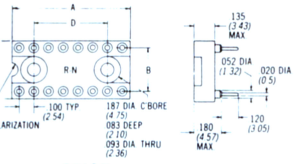
• Pin socket contacts for high reliability and high retention • Four finger BeCu contact grabs pin on all four sides • Low profile body with mounting holes • End and side stackable • 30μ inch gold 2 level wire wrap • Tin plated shell with gold plated contacts saves cost on solter tail.

HIGH RELIABILITY WIRE WRAP

PART NO.	PINS	PRICE 1-9	10-24	25-99	100-24	250-99
RNH08HRW	8	1.10	1.00	.90	.86	.77
RNH14HRW	14	1.65	1.55	1.45	1.30	1.15
RNH16HRW	16	1.85	1.65	1.55	1.40	1.25
RNH18HRW	18	2.10	1.90	1.85	1.65	1.60
RNH20HRW	20	2.45	2.10	2.00	1.80	1.70
RNH22HRW	22	2.55	2.30	2.10	2.00	1.90
RNH24HRW	24	2.75	2.50	2.20	2.10	2.00
RNH28HRW	28	3.25	3.00	2.60	2.50	2.40
RNH40HRW	40	4.50	4.25	4.00	3.60	3.40

HIGH RELIABILITY SOLDER TAIL



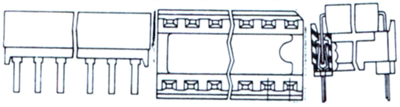


PART NO.	PINS	PRICE 1-9	10-24	25-99	100-24	250-99
RNH08HST	8	.70	.55	.45	.41	.36
RNH14HST	14	.75	.76	.61	.57	.55
RNH16HST	16	1.05	.83	.68	.64	.62
RNH18HST	18	1.20	.96	.78	.74	.70
RNH20HST	20	1.35	1.08	.85	.78	.74
RNH24HST	22	1.50	1.19	.92	.88	.80
RNH24HST	24	1.60	1.26	1.00	.95	.85
RNH28HST	28	1.90	1.50	1.15	1.10	1.00
RNH40HST	40	2.70	2.16	1.96	1.75	1.56

TEXAS INSTRUMENTS

FACE GRIP LOW PROFILE SOLDER TAIL DIP SOCKETS C85 SERIES

ONE

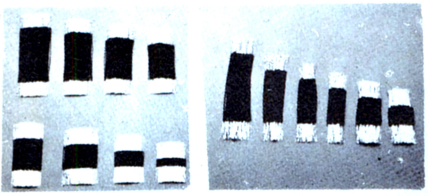


PART NO.	PINS	1-9	10-49	50-99	100-499	500-999	1,000+
TIS08LP	08	N/A	.15	.10	.08	.07	.06
TIS14LP	14	N/A	.18	.15	.14	.12	.11
TIS16LP	16	N/A	.20	.18	.16	.13	.12
TIS18LP	18	.30	.25	.22	.18	.15	.13
TIS20LP	20	.30	.25	.23	.20	.17	.145
TIS22LP	22	.35	.30	.25	.22	.19	.17
TIS24LP	24	.40	.35	.30	.24	.20	.18
TIS28LP	28	.45	.40	.35	.28	.24	.21
TIS40LP	40	.50	.45	.42	.40	.35	.31

*MINIMUM ORDER $1.00 Per Line Item

page

PRECUT WIRE WRAP WIRE
Precut Wire Save Time and Costs Less Than Wire on Spools



Kynar precut wire. All lengths are overall, including 1" strip on each end. Colors and lengths cannot be mixed for quantity pricing. Choose from colors **Red** (R), **Blue** (U), **Black** (B), and **Yellow** (Y).

PART NO.	LENGTH	/C 100/Tube	/D 500/Tube	/M 1000/Tube
PG025†*	2.5"	$1.38	$3.94	$6.19
PGP030†*	3.0"	1.43	4.25	6.78
PGP035†*	3.5"	1.51	4.57	7.37
PGP040†*	4.0"	1.56	4.88	7.94
PGP045†*	4.5"	1.63	5.21	8.54
PGP050†*	5.0"	1.69	5.54	9.13
PGP055†*	5.5"	1.74	5.92	9.72
PGP060†*	6.0"	1.82	6.23	10.31
PGP070†*	7.0"	2.19	7.44	12.44
PGP080†*	8.0"	2.35	8.12	13.79
PGP090†*	9.0"	2.46	8.92	15.01
PGP100†*	10.0"	2.63	9.58	16.28

† Specify package size when ordering: 100 (C), 500 (D), 1000 (M).
*** Specify color when ordering. RED (R), BLUE (U), BLACK (B), & YELLOW (Y).**

Example: If you wish to order (2) pkg. 1000 4", Red:

2 PGP040MR $7.94 $15.88

BUY PRECUT WIRE IN KITS AND SAVE

PGPWKI* **$9.95**

CONTAINS			
200	3"	100	4½"
200	3½"	100	5"
100	4"	100	6"

PGPWK2* **$24.95**

CONTAINS			
250	2½"	250	5"
500	3"	100	5½"
500	3½"	100	6"
500	4"	100	6½"
250	4½"	100	7"

PGPWK3* **$34.95**

CONTAINS			
250	2½"	500	4½"
500	3	500	5"
500	3½"	500	5½"
500	4"	500	6"

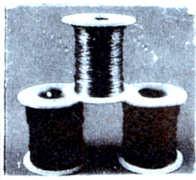
PGPWK4* **$59.95**

CONTAINS			
500	2½"	1000	4½"
1000	3"	1000	5"
1000	3½"	1000	5"
1000	4"	1000	6"

*Wire kit assortments are available in the 4 colors mentioned above along with a rainbow assortment. Use color code (A) for the rainbow assortment. Example: If you wish to order (2) wire kit 3 in blue:

2 PGPWK3U $32.95 $65.90

SPOOLED 30 GAUGE KYNAR



PART NO.	SPOOL LENGTH	1-4	5-9
PGS100*	100 ft.	3.95	3.60
PGS250*	250 ft.	6.50	6.00
PGS500*	500 ft.	11.95	11.00
PGS1000*	1000 ft.	19.95	18.00

* Specify color when ordering. **Red** (R), **Blue** (U), **Black** (B), **Yellow** (Y)

Example: if you wish to order 400 ft. of yellow:

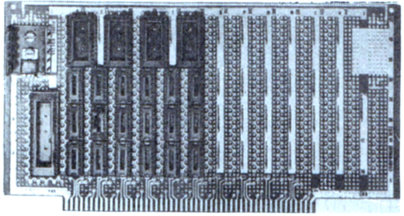
4 PGS100Y $3.95 $15.60

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

Vector S100 PRODUCTS

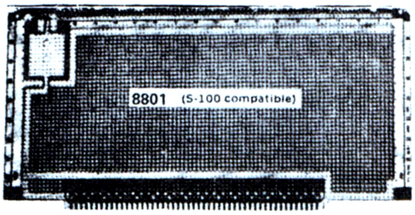
COMPATIBLE PLUGBOARDS FOR INTERFACE, MEMORY EXPANSION, EXPERIMENTATION



VCT8800V

Universal Microcomputer/processor plugboard use with S-100 bus. Complete with heat sink & Hardware. 5.3" x 10" x 1/16."

1-4	5-24	25+
$22.48	$20.23	$17.98



VCT8801

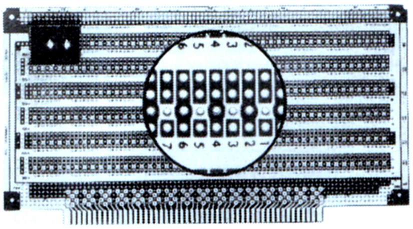
Individual tinned square pads surround most holes. Ideal for mounting components by "tack" soldering. Top of board pod free for mounting I/O connectors.

1-4	5-24	25+
$23.12	$20.81	$13.50

VCT8801-1

Plain no etched circuitry except contacts. Produces maximum flexibility.

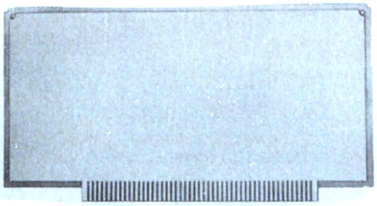
1-4	5-24	25+
$15.67	$14.10	$12.54



VCT8804

"ANY DIP" has full power and ground planes back to back. Boards accomodates .3, .4, .6, .9" Dips.

1-4	5-24	25+
$25.90	$23.31	20.72

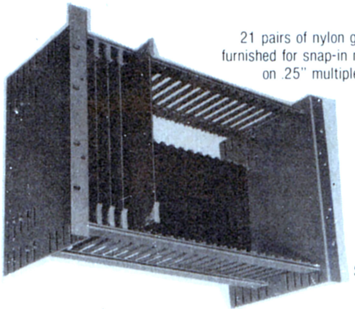


VCT8800R2

Positive photo resist coating over copper and gold plated contacts both sides. Make your own custom two sided S100 PC board. Expose develop, etch — no camera or darkroom needed.

1-4	5-24	25+
$23.99	$21.59	$19.90

VCT0088-21-45 developer for + Positive Photoresist, 6 oz. concentrate makes 30 fluid ounces, develops 2400 square inches **$2.57**



21 pairs of nylon guides furnished for snap-in mounting on .25" multiples

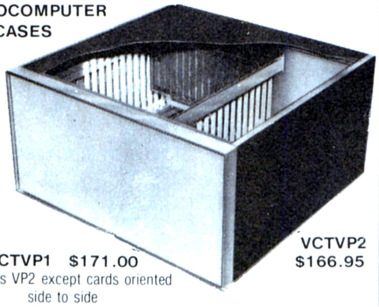
Shipping Wt. 10 lbs.

VCTCCK100 $51.79

RACK MOUNTABLE CAGE

Especially designed to accomodate S100 size Plugboards, Motorola Exocisor™ and Micromodule™ Plugboards. Cage has .081" thick anodized aluminum side walls. Will accommodate Plugboards 4.0" to 8.5" long and 10.0" to 11.5" wide by 1/16" thick. Cages assemble quickly. *TM Registered Motorola trademark.

VECTOR-PAK ASSEMBLED MICROCOMPUTER CASES



VCTVP1 $171.00

Same as VP2 except cards oriented side to side

VCTVP2 $166.95

Adjustable packaging system for S-100 bus microcomputers, compatible with Altair 8800 and IMSAI 8080 size cards. Smart looking, deluxe cases unmarred by unsightly screws or fasteners. Finished in dark blue textured vinyl. Instantly accessible interiors with slip outcovers. Removable recessed rear and front panels. Fully adjustable interior mounting systems for any card or card spacing within size limitations. No cutting or drilling necessary. Perforated bottom cover for cooler operation.

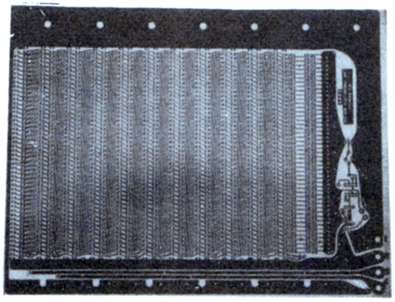
Assembled case with perforated bottom cover. Installed mounting struts for card guides and receptacles or motherboard. Cards top loaded, spanning front to back. Card guide (12 pair) and chassis plate supplied uninstalled.

Shipping Weight 25 lbs.

INPUT/OUTPUT CONNECTOR REAR PANEL

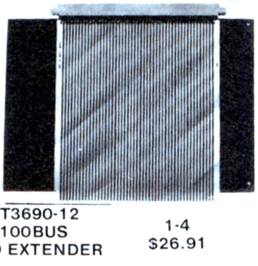
VCTBP17-9 $10.95

Ten connector cutouts for ITT Cannon DB25S Type 25 pin connector (connectors furnished by user). Panel may be installed with cutouts on either right or left side. Interchangeable with standard rear panel. Connectors may be slipped through the panel for ease of assembly or disassembly.



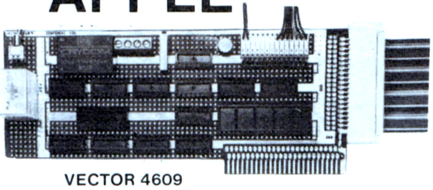
VCT8803 MOTHERBOARD $31.57

Eleven connector positions ready for connectors. With solder plated circuitry for active termination, solder mask, large buses. Fits VP1, VP2 and standard Imsai type enclosures. User supplies components. (2 lbs.)



VCT3690-12 S100BUS CARD EXTENDER	1-4	5-24
	$26.91	$24.22

APPLE



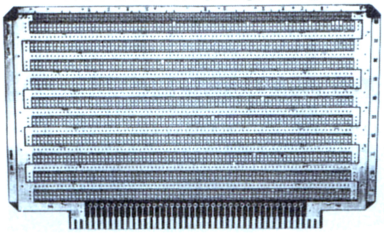
VECTOR 4609

Peripheral Interface Plugboard for construction of custom circuits. Plug compatible with Apple II, Commodore PET and Super Kim microcomputers.

VCT4609

1-4	5-24	25+
$23.00	$20.70	$18.40

MOTOROLA EXORCISER PROTOTYPING BOARDS



VCT4611

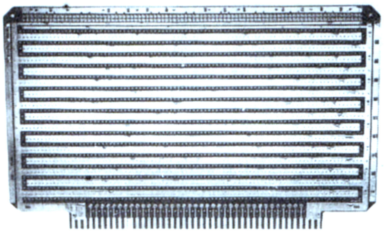
3 hole pads interspersed with power busses (above)

1-4	5-24	25+
$29.95	$26.96	$23.96

VCT4611-1

Bare board except with edge connector. No power bussing.

1-4	5-24	25+
$19.95	$17.96	$15.96

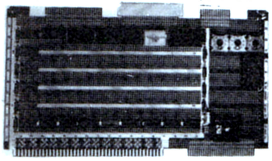


VCT4611-2

Has only interspersed busses.

1-4	5-24	25+
$29.95	$26.96	$23.96

MULTIBUS



VCT4608

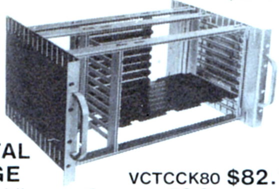
Form and size compatible with INTEL SBL80 Series and NATIONAL BLC 80 Series Microcomputer boards. Power and Ground buses on both sides.

1-4	5-24	25+
$59.23	$63.51	$47.38

VCT4608-1

Same as 4608 except plain, less power buses.

1-4	5-24	25+
$40.02	$36.02	$32.02



HORIZONTAL CARD CAGE

VCTCCK80 $82.16

For S-100, Multibus, or Exorciser PC Cards

- Capacity up to 10 cards depending on card spacing
- Plastic card guides slide and lock to any card spacing.
- Variable mounting for receptacles or motherboard
- Fully assembled in Multibus position
- Aluminum construction
- Handles not included

Sh. Wt. 10 lbs.

VCTHA9
Pkg. of 4 **$1.34**

Ejector Card with Roll Pin
VCTHA9C
Pkg. of 100 **$27.60**

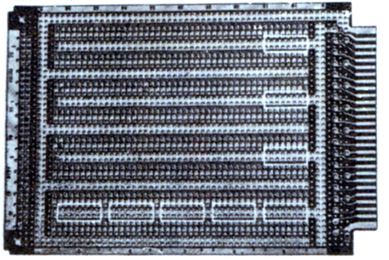
WE ACCEPT VISA, and MASTER CARD

PRIORITY ONE ELECTRONICS

Vector

UNIVERSAL MICROCOMPUTER PLUGBOARDS

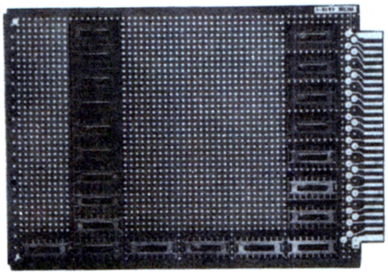
For STD Bus, Pro-Log Microprocessors and General Use. Size 4.5" x 6.5" x.052" 28/56 contacts on .125" centers.



VCT4610

For soldering or wire wrapping. Mounts 20 16-pin DIP IC's.

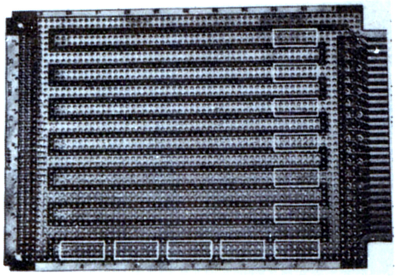
1-4	24	25+
$18.95	$17.06	$15.16



VCT4610-1

For soldering or wire wrapping. Mounts 59 16-pin DIP IC's.

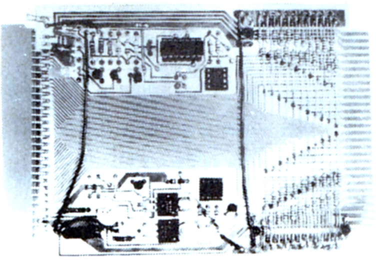
1-4	24	25+
$15.95	$14.36	$12.76



VCT4610-2

Wire wrapping board. Mounts 35 16-pin DIP IC's.

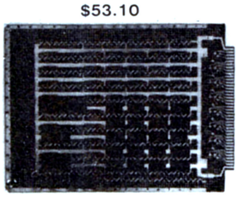
1-4	24	25+
$18.95	$17.06	$15.16



VCT4610-6

Active terminator for STD and STD-Z80 bus. Also functions as extender board with built-in logic probe. Vector supplies attached receptable. User supplies other components.

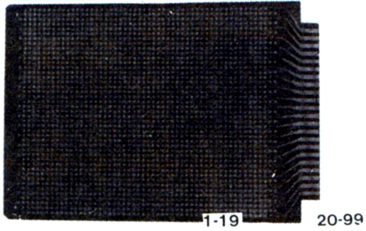
1-4	5+
$59.00	$53.10



VCT4350

Large Microprocessor development plugboard with Zig-zag busses 7" x 9.6". Mounts 77 DIP IC's. 80pin connector spaced 0.125".

1-4	24	25+
$23.94	$21.55	$19.15



		1-19	20-99
VCT3662	6.5" x 4.5"	$9.96	$8.76
VCT3662-2	9.6" x 4.5"	$10.85	$9.83

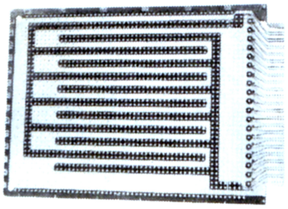
P pattern plugboards for ICs Epoxy Glass 1/16" 44 pin con. spaced .156.

	1-19	20-99
VCT3719-1	$9.74	$8.77

Same as 3662 except 36/72 con. on .1 centers

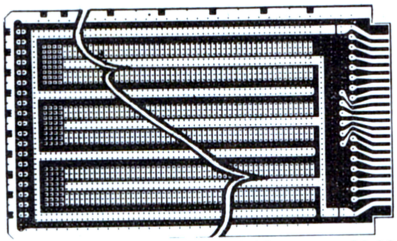
VCT3719-4 $11.43

Same as 3662-2 except 36/72 con. on 1 centers



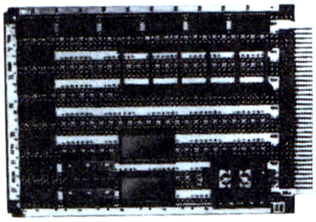
Hi-density dual In-line plugboard for wire wrap - with Power and Gnd bus. 1/16" Epoxy Glass, 44pin connectors, spaced 0.156".

		1-19	20-99
VCT3682	9.6" x 4.5"	$13.63	$12.27
VCT3682-2	6.5" x 4.5"	$11.54	$10.39



		1-19	20-99
VCT3677	9.6" x 4.5"	$13.33	$12.00
VCT3677-2	6.5" x 4.5"	$11.75	$10.58

General purpose DIP boards with bus pattern for solder or wire wrap. 1/16" Epoxy glass, 44pin connectors, spaced 0.156".



VCT4493-1

4.5" x 9.6" Universal pattern for any .3", .4", .6", .9", spaced DIPS. Holds 63 Dips. Accommodates additional I/O connectors 36/72 con. on .1 centers.

1-4	24	25+
$25.06	$22.50	$20.05

VCT4493

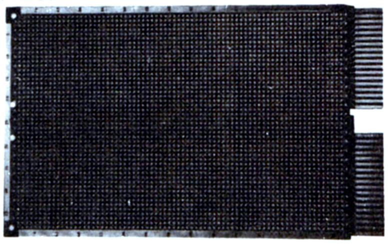
4.5" x 6.5" Universal pattern for any .3", .4", .6", .9" spaced DIPS. Accommodates additional I/O connectors 36/72 con. on .1 centers.

1-4	5-24	25+
$20.34	$18.31	$16.27

VCT4494

Same as 4493 except 22/44 con. on .156 centers.

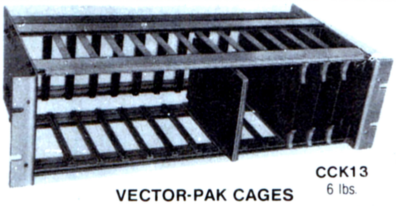
1-4	5-24	25+
$16.81	$15.13	$13.45



VCT4607

DEC, LSI-11, PDP8, PDP11, Heath H-11, P Pattern Epoxy Glass, Plug Board 8.43" x 5.187". Dual 36 pin DEC/HEATH Connectors.

1-4	5-24	25+
$17.07	$15.36	$13.60



CCK13
6 lbs.

VECTOR-PAK CAGES

19" rack mounting cages are supplies completely assembled, ready for connectors. Models listed accommodate 1/16" thick cards 4.5" maximum to 3" minimum width x 6.5" long. Heavy extruded aluminum cross members (T-Struts) provide strength and easy, infinitely variable connector spacing. 21 pairs of 4-40 connector mounting nuts are furnished installed.

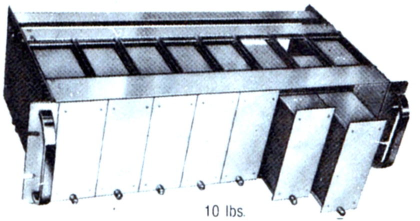
VCTCCK-3 Card Cage — Has 108 grooves 0.075" wide for 1/16" circuit cards in extruded aluminum plates mounted top and bottom. Vertically and horizontally adjustable rear cross members have 21 pairs of 4-40 nuts in captive grooves for easy connector mounting. . . . **$49.80**

VCTCCK-13 Card Cage — 19" wide x 5¼" high x 8.9" deep. Has 21 pairs of riveted anodized aluminum card guides. . . . **$52.00**

VCTCCK-13P Card Cage — Same as No. CCK13, except with riveted ABS plastic guides. . . . **$52.00**

VCTCCK-14P Card Cages — 19" wide x 5¼" high x 12" deep. Has 21 pairs of riveted card ABS plastic card guides on 0.75" centers. . . . **$59.94**

VCTCCK13S — Same as CCK-13, except for snap in card guides. Comes in kit form. . . . **$42.64**



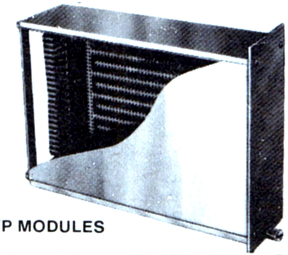
10 lbs.

The Vector Pak system is a coordinated packaging system which provides modular cases and cages for nearly all Vector Plugboards and many industry-standard plug-in boards. Adjustable rear struts mount almost any PC connector without hole drilling or special brackets. Other sizes and cage parts are available separately — write for catalog.

VCTCMA3A 20 Cage — 5¼" h. x 8.9" deep fits 19" racks. Holds eight 2" wide x 6½" long x 4.6" high modules (Vector No. EFP204A66). . . . **$65.93**

VCTCMA4A 20 Cage — 5¼" h. x 12' deep fits 19"racks. Holds eight 2" wide x 9.6" long x 4.6" high modules (Vector No. EFP204A96). . . . **$67.19**

VCTCMA3A 16 Cage — Same as No. CMA3A-20, except holds ten 1.6" wide x 6.6" long x 4.6" high modules (Vector No. EFP164A66). . . . **$71.81**



2 lbs.

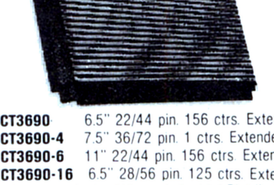
EFP MODULES

All-aluminum modules are anodized finished and have 5¼" high front panels with thumb screw, solid rear panels for connector mounting or circuit board slotting, rear sliding side covers, plus inner multiple-grooved top and bottom rails to hold 1/16" thick circuit boards without special bracketing.

VCTEFP164A66 Case — Has 6 circuit board grooves spaced 0.150" apart on top and bottom rails, holds circuit boards 4.5" wide x 6.5" maximum length inside. . . . **$10.84**

VCTEFP204A66 Case — Same as No. EFP164A66, except has 9 circuit board grooves . . . **$11.15**

VCTEFP204A97 Case — *Same as No. EFP164A66, except holds circuit boards 4.5" wide x 9.6" maximum length inside.* . . . **$12.79**



Card Extenders

VCT3690	6.5" 22/44 pin. 156 ctrs. Extender	**$15.97**
VCT3690-4	7.5" 36/72 pin. 1 ctrs. Extender	**$23.22**
VCT3690-6	11" 22/44 pin. 156 ctrs. Extender	**$18.85**
VCT3690-16	6.5" 28/56 pin. 125 ctrs. Extender	**$21.42**

P1E is an authorized Vector Industrial Distributor. We carry the entire Vector line so call us for any Vector products that you need. The full line Vector catalog is available to qualified industrial and institutional customers. Order part number **VCTCATALOG**, Shipping weight 2 lbs.

CALL FOR VECTOR ITEMS NOT LISTED

PRIORITY ONE ELECTRONICS

1 ONE

SLIT-N-WRAP

Slit-N-Wrap is easy to use and is up to four times faster than ordinary manual wrapping because there is no wire mearsuring or prestripping required. Slit-N-Wrap tools have a patented action which slits wire insulation while the tool is wrapping wire on .025" square posts. Connections are just as reliable as with conventional wrapping tools. Tests show Slit-N-Wrapped connections exceed Mil Spec requirements for pull-off, are low resistance, and are gas tight. All tools and bits are guaranteed to provide at least 10,000 reliable wraps before bit replacement is required.

- The P184 series tools use rugged Tefzel insulation .005 inches thick over silver plated solid 28 gage copper wire. Tefzel insulated wire is a standard wrapping wire combining the best features of Kynar (high abrasion resistance) and Teflon (low crosstalk from low dielectric constant of 2.6) and a high temperature rating above Kynar. The P184 series tool gives a type of modified wrap for rugged duty. Kynar wire of equal size may be used but tip life would be reduced by about half.
- The P180 series tool use a thin but tough polyurethane insulation with nylon coating (.0008 inches thick) over bare solid 28 gage copper wire. This gives the most compact wraps and uniquely permits transition from .025 inch square solderless wrap posts, or may be soldered to soldered components by soldering thru the insulation with a 750 —850 Farenheit iron for unusual conditions.

7-TURN COUNTER 110V AC SLIT-N-WRAP TOOLS

VCTP184-7 for 28ga. Tefzel wire $198.00

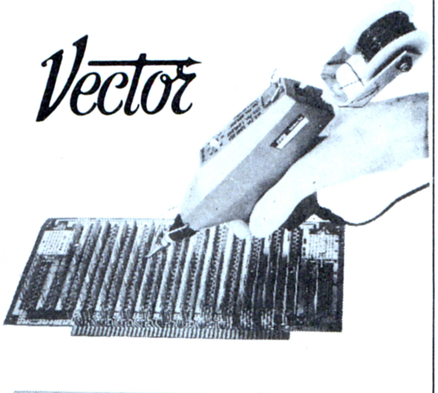
110V AC power Slit-N-Wrap tool with electronic 7-turn counter (also adjustable to 3, 5, 9 turns or continuous run). Assures uniform number of turns for each pull on trigger. Other features same as for P183-3.

P180-7 for 28 ga. polyurethane nylon wire $132.66

Similar to P184-7 except for 28 ga. polyurethane wire on 100' spool(2 spools supplied).

Carries 01 bit. Other features same as for P180-3.

Vector



VECTOR P160 1B

P160-1 B UNWRAP TOOL

Unwrapping bit is recessed far enough into the sleeve (spring loaded) to permit unwrapping more than the maximum amount of turns on a 3 wrap post for 26-30 gage wire.

VCTP160-1B.....................$12.50

Vector

VCT P184-3 Power Slit-N-Wrap tool (110V AC) for Tefzel Wire $125.00

Has 300' spool of Tefzel 28 ga. wire with tension regulator spring to reduce wire breakage. (50' spools may be used with extra plug-in mounting, P-160-5C, or with spacers provided, on regular mount)

Has new 2-piece housing for wrap bit shaft with stationary wire gripper at tip to avoid need to hold wire end at start of wrap.

Wrap bit shaft no. 02 is set-screw mounted to rear half of bit housing for easy and low cost replacement.

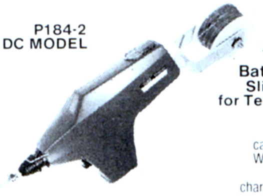
External power transformer with cord, P183 cut off & forming tool and P137 set screw key are supplied.

VCTP180-3 Power Slit-N-Wrap Tool (110V AC) for Polyurethane Wire. $125.00

Has same features as P184-3 except that two 100' spools of polyurethane nylon insulated wire are supplied instead of Tefzel for more compact wire wrapping, and has no. 01 wrap bit for polyurethane nylon wire.

BATTERY OPERATED SLIT-N-WRAP TOOLS

P184-2
DC MODEL



VCTP184-2
Battery Operated
Slit-N-Wrap Tool
for Tefzel Wire $125.00

Features same as above P184-3 except is nickel cadmium battery powered. Will wrap more than 7000 posts per charge. AC recharging unit included. Other accessories same as P184-3.

VCT P180-2 Battery Operated Slit-N-Wrap Tool for Polyurethane Wire $125.00. Has same features as P184-2 except that two 100' spools of polyurethane-nylon thinly insulated wire are supplied for more compact wire wrapping. (care must be used to avoid breaking insulation around sharp corners), no. 01 wrap bit installed. Other accessories same as with P184-3.

VCTP184-5 Manual Slit-N-Wrap Tool for Tefzel Wire. $44.00

Mounts 50' spools of Tefzel 28 ga. wire. New tension regular spring reduces wire breakage. 300' spools may be used with larger plug-in mounting P160-5F. (extra)

Has new 2-piece housing for wrap bit shaft with stationary wire gripper sleeve at tip to avoid need to hold wire end at start of wrap. User must hold spring on housing with one hand and twist handle with other hand. This anchors end of wire when starting wrap.

Wrap bit shaft no. 02 is set-screw mounted to rear half of bit housing for easier and lower cost replacement.

One extra 50' spool of Tefzel wire, a P183 cut off and forming tool, P208-1 wrench, P137 set screw key, and tension tester weight are included.

VCTP180-5 for Polyurethane Wire $44.00

Has same features as P184-5 except that two 100' spools of polyurethane wire me as P184-5 except that it is supplied with 1-pc wrap bit housing (no wire grip tip) for reduced cost.

VCTP184-1 for Tefzel Wire $39.00

Same as P184-5 except that it is supplied with 1-pc. wrap bit housing (no wire grip tip) for reduced cost.

VCTP180-1 for Polyurethane Wire $39.00

Same as P180-5 except that it is supplied with 1-pc. wrap bit housing (no wire grip tip) for reudced cost.

ORDER RETROFIT PARTS LISTED FOR LATEST INNOVATIONS ON EARLIER TOOLS

Earlier Tool Models	1-pc bit housing with set-screw mtg. for removable bit shaft	2-pc. wire grip bit or sleeve with set screw mtg. for removable bit shaft & stationary wire gripper	Replacement wrap bit for set screw mtg. Requires 1- or 2-pc housing at left	Bracket w/tension regulator for 50' Tefzel or 100' polyurethane wire spools	Brackets w/tension regulator for 300' wire spools
P180	VCTPH06 or	VCTPH07	VCT01	VCTP160-5C	
P160-4T	VCTPH06 or	VCTPH05*	VCT01	VTCP160-5C	
P160-4T1	VCTPH06 or	VCTPH05*	VCT01	VCTP160-5C	
P180A	VCT0187 †				
P184	VCTPH06 or	VCTPH07	VCT02	VCTP160-5C	VCTP160-5D
P184-4T	VCTPH06 or	VCTPH05*	VCT02	VCTP160-5C	VCTP160-5D
P184-4T1	VCTPH06 or	VCTPH05*	VCT02	VCTP160-5C	VCTP160-5D
P184A	VCT0188 †				

*Drill (2) .059" holes per included instruction to accept spring mounts † Includes housing and wrap bit

REPLACEMENT WIRE
AWG 28 Tefzel Insulated Silver Plated Wire

PART NO.	COLOR	FEET PER SPOOL	SPOOLS PER PKG.	PRICE
VCTW28-6A	Green	50	2	$ 5.39
VCTW28-6B	Red	50	2	$ 5.39
VCTW28-6D	Blue	50	2	$ 5.39
VCTW28-6E	White	50	2	$ 5.39
VCTW28-6F	Yellow	50	2	$ 5.39
VCTW28-6H	Black	50	2	$ 5.39
VCT28-6AS	Green	300	1	$14.95
VCTW28-6BS	Red	300	1	$14.95
VCTW28-6DS	Blue	300	1	$14.95
VCTW28-6ES	White	300	1	$14.95
VCTW28-6FS	Yellow	300	1	$14.95
VCTW28-6HS	Black	300	1	$14.95
AWG 28 Polyurethane-Nylon Wire				
VCTW28-2A	Green	100	3	$ 3.53
VCTW28-2B	Red	100	3	$ 3.53
VCTW28-2C	Clear	100	3	$ 3.53
VCTW28-2D	Blue	100	3	$ 3.53

Set Screw Mounted Replacement Wrap Bits

VCT02	For Tefzel Wire (P184 Series)	Pkg. 2	**$21.20**
VCT01	For Polyurethane Wire (P180	Pkg. 2	**$21.20**

For Polyurethane Wire (P180 Series)

Tension regulated bracket for 50' spools (order spooled wire separately). Use with all models or power Slit-N-Wrap tools. Use P160-5E on manual Slit-N-Wrap tools.

VCTP160-5C $12.40 ea.
VCTP160-5E $11.00 ea.

P160-5D tension regulated bracket for 300' spools (order spooled wire separately). For use with all power Slit-N-Wrap tools. P160-5F for use with manual tools.

VCTP160-5D $12.40
VCTP160-5F $11.00

PH05
PH06
PH07

VCTPH05 2-Piece Wire-Grip Bit Housing with spring mounting to fit original type power tools **$10.76**

NOTE: To use these on earlier tools, customer will need to drill (2) .059" holes in front part of tool to accept spring mounts. Instructions supplied with housing.

VCTPH06 1-Piece Bit Housing with setscrew mounting for no. 02 or no. 01 removeable bit shaft ...... **$5.50** (When bit shaft is added, unit will be similar to former P184A or P180A replacement bits respectively, except that bit shafts are now replaceable at lower cost).

VCTPH07 2-piece Wire-Grip Bit Housing with spring mounting to fit earlier type manual tools ...... **$5.70** Wrap bit (order separately) mounts on rear half of housing with set screw. Set screw key included. Sleeve removable.

Vector

1/16 BOARD
.042 dia. holes on
0.1 spacing for IC's

EPOXY GLASS	SIZE	PRICE 1-9	PRICE 10-19
VCT64P44	4.5"x6.5"	$1.83	$1.65
VCT84P44	4.5"x8.5"	$2.25	$2.03
VCT169P44	4.5"x17"	$4.61	$4.15
VCT169P84	8.5"x17"	$9.00	$8.10
PHENOLIC			
VCT64P44X	4.5"x6.5"	$1.56	$1.40
VCT169P44X	4.7"x17"	$3.69	$3.32

MICRO CLIP

For .042 dia. holes. (all boards this catalog)

VCTT42-1/C	Pkg. of 100	$ 1.77
VCTT42-1/M	Pkg. of 100	$11.28
VCTP149 Hand installing tool		$ 3.76

"J" PINS

"J" wire wrap pins for use with T42-1 or as wire wrap or patchcord post for .042" holes. .1 spacing. (All boards this catalog)

VCTK32/C	Pkg. 100	$ 3.04
VCTK32/M	Pkg. 1000	$18.95

WRAP POST

For 0.42" dia. holes (all boards in this catalog). Bifurcated contacts for soldering components above board and .025" sq./wrap post below board. T44 will accept a .021", max. dia. lead in bifurcated end. 3 level wrap post.

VCTT44/C	Pkg. of 100	$ 2.44
VCTT44/M	Pkg. of 1000	$14.35
VCTA13 Hand installing tool		$ 4.92

T68 will accept a .032" max. dia. lead in bifurcated end. 3 level wrap post.

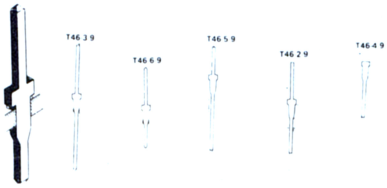
VCTT68/C	Pkg. of 100	$ 3.00
VCTT68/M	pkg. of 1000	$18.91
VCTA13-1 Hand installing tool		$ 4.15

T68A will accept a .032" max. dia. lead in bifurcated end. 2 level wrap post.

VCTT68A/C	Pkg. of 100	$ 2.67
VCTT68A/M	Pkg. of 1000	$16.05
VCTA13-1 Hand installing tool		$ 4.15

T46 SERIES WRAP POST

T46-3-9 T46-6-9 T46-5-9 T46-2-9 T46-4-9



Feed-thru wrap post fits plated-thru or plain holes. Sharp Corners on these .025" sq. wrap post bite into wrapped wires for perfect connections.

VCTT4629/C	Pkg. 100	$ 2.86
VCTT4629/M	Pkg. 1000	$21.48
VCTT4639/C	Pkg. 100	$ 3.00
VCTT4639/M	Pkg. 1000	$22.41
VCTT4649/C	Pkg. 100	$ 2.77
VCTT4649/M	Pkg. 1000	$17.76
VCTT4659/C	Pkg. 100	$ 2.92
VCTT4659/M	Pkg. 1000	$21.64
VCTT4669/C	Pkg. 100	$ 5.24
VCTT4669/M	Pkg. 1000	$45.11

VCTP133B Hand installing tool $ 3.51

TRIFURCATED KLIP WRAP POST

For .010" to .040" diameter leads above board and .025" sq/3-level wrap post below board for .042" dia holes (All boards this catalog)

VCTT49/C	Pkg. 100	$ 3.29
VCTT49/M	Pkg. 1000	$26.90
VCTP156 Hand installing tool		$ 4.11

SOCKET PINS

Gold plated machined socket pin for .042" dia. holes (All boards this catalog) With 3 level post

VCTR32	Pkg. 25	$ 5.76
VCTR32/C	Pkg. 100	$ 21.54
VCTR32/M	Pkg. 1000	$200.72
VCTP158 Impact insertion tool		$ 24.25
VCTD9 Die point for P158		$ 4.71

T107 Bus Strip T112-1 Bus Link T112-2 Bus Link

T107 BUS STRIP

Used for supply busses on Vector board. Holes are .1" Centers 13" long.

VCTT107	Pkg. 10	$ 4.23
VCTT107/C	Pkg. 100	$40.12

T112-1 BUS LINK

Fits over WW pin and connects pin to bus .2" long.

VCTT1121/C	Pkg. 100	$ 1.93
VCTT1121/M	Pkg. 1000	$ 8.50

T112-2 BUS LINK

Same as T112-1 except 3" long.

VCTT1122/C	Pkg. 100	$ 2.15
VCTT1122/M	Pkg. 1000	$10.95

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

Model X1000W's mini size and Finger-eze Hypo-Action permit direct multiple hookups to one pin, even with wire wraps, connects vertically or horizontally

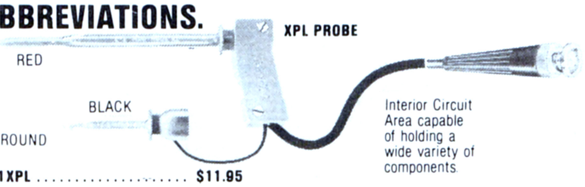
IMPORTANT ORDERING INFORMATION

1 ONE

Most Items Available in 10 Retma Colors:

BK - BLACK
BR - BROWN
RD - RED
OR - ORANGE
YE - YELLOW
GN - GREEN
WH - WHITE
S - ONE OF EACH OF ALL 10 COLOR

COLOR: Must be replaced with one of the above **ABBREVIATIONS.**



Interior Circuit Area capable of holding a wide variety of components.

EZH4061XPL $11.95

X100W MINI HOOK

EZHX100W - COLOR	$ 1.05
EZHX100W S - 1 ea. 10 colors	$10.00

JUMPER – MINI-HOOK TO MINI-HOOK

$2.20
$21.00

SPECIFY LENGTH

Part Number	Wire Lgth. Inches	Price
EZH20412COLOR	12	$ 2.20
EZH20412S 1 ea. 10 colors	12	$21.00
EZH20424COLOR	24	$ 2.20
EZH20412S 1 ea. 10 colors	24	$21.00
EZH20436COLOR	36	$ 2.20
EZH20436S 1 ea. 10 colors	36	$21.00

MINI-HOOK TO STACKING BANANA PLUG

EZH201 W-RD or BK .... $ 2.20

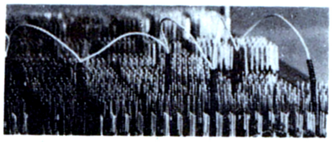
MINI-HOOK TO MINIATURE BANANA PLUG

EZH201 W-RD or BK .... $ 2.50

MINI-HOOK TO .025" (.635 mm) SQUARE SOCKET WITH HEAT SHRINK INSULATOR

24"

EZH20324 RD or BK .... $ 2.10



E–Z–LINK

.25" SQUARE SOCKET CONTINUOUS JUMPERS

Consisting of insulated .025" (.635mm) Square Socket Connectors evenly spaced on 3" centers. E-Z-Links individually snap over standard wire wrapping pins to form any desired network.

EZHL325-BK or RD pkg. of 25 .... $21.00

XM MICRO HOOK

EZHXMCOLOR	$ 1.10
EZHXMS 1 ea. 10 colors	$10.50

JUMPER – MICRO-HOOK TO MICRO-HOOK

SPECIFY LENGTH

Part Number	Wire Lgth. Inches	Price
EZHXM12COLOR	12	$ 2.40
EZHXM12S1 ea. 10 colors	12	$22.50
EZHXM24COLOR	24	$ 2.40
EZHXM24S1 ea. 10 colors	24	$22.50
EZHXM36COLOR	36	$ 2.40
EZHXM36S1 ea. 10 colors	36	$22.50

MICRO-HOOK TO STANDARD BANANA PLUG

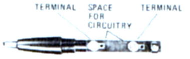
32"/80cm

EZHBXMRD or BK .... $ 2.10

TEST CABLE WALL BRACKET

Deep Slots hold Test Cables for Easy Selection. Half slot on each end permits mounting of two or more units side by side with no loss of space between racks

EZHWB6 - $4.00



SLIM-LINE TEST CONNECTOR

Slim Line Probe with lightweight construction. Screw on cover for ready access to repair or replace internal circuitry or connections.

EZH541 RD or BK .... $ 2.25

SPECIFY LENGTH

BNC MALE TO BNC MALE, WEATHERPROOF WITH STRAIN RELIEF BOOTS

Cable: RG58C/U

Part Number	Wire Lgth. Inches	Price
EZH102624	24	$ 7.50
EZH102636	36	$ 7.50
EZH102648	48	$ 7.50

BNC FEMALE TO BNC

EZH9220 .... $ 3.20

BND FEMALE TO UHF MALE ADAPTER

EZH9001 .... $ 4.20

STANDARD BANANA PLUG

EZH9202-COLOR pkg. 2 .... $ 1.50

PANEL MOUNT STANDARD BANANA JACK

EZH9217-COLOR pkg. $ .... $ 3.00

BNC FEMALE TO STANDARD DOUBLE BANANA PLUG ADAPTOR

EZH9225 .... $ 3.95

BNC FEMALE PANEL RECEPTACLE

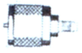
EZH9230 .... $ 1.50

BNC MALE CONNECTOR FOR RG58C/U CABLE

EZH8901 .... $ 2.50

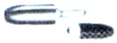
BNC T ADAPTOR - 2 FEMALE AND 1 MALE CONNECTORS

EZH9238 .... $ 8.75



UHF MALE CONNECTOR FOR RG58C/U CABLE

EZH8911 .... $ 2.25



STACKING BANANA PLUG

EZH9203 RD or BK pkg. 2 .... $ 1.65

STANDARD BANANA JACK

EZH9210 RD or BK pkg. 2 .... $ 1.65

STACKING DOUBLE BANANA PLUG

EZHDB750 .... $ 2.25

ALLIGATOR CLIP LEAD SETS

10 color coded mini clip, leads 15 inches long. 2 each red, green yellow, black, and white

CALACL1015 $2.69

10 color coded standard clip leads 15 inches long. 2 each red, green, yellow, black, and white.

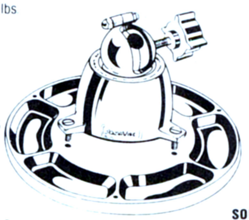
CALACL101H $3.19

PANAVISE

LOW-PROFILE BASE

$13.95 PNV305

Sh.Wt. 2 lbs.

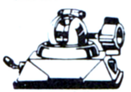


$13.95

PNV312 TRAY BASEMOUNT

VACUUM BASE

$21.95 PNV380



Sh.Wt. 2 lbs.

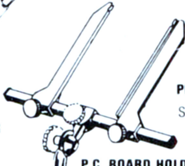
Sh.Wt. 2 lbs.

HORIZONTAL JAW VISE HEAD

$18.95 PNV304

SOLDER & IRON HOLDER

PNV371 $5.95 9 oz

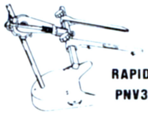


PNV315 $19.95

Sh.Wt. 1 lb

P.C. BOARD HOLDER with 14" bar

Fits S-100Boards



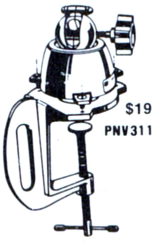
RAPID ASSEMBLY CIRCUIT BOARD HOLDER

PNV333 $39.95 Sh.Wt. 8 lbs.

STANDARD BASE

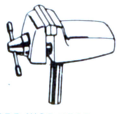
PNV300 $13.95

Sh.Wt. 2 lbs.



$19.95

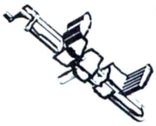
PNV311 Sh.Wt. 3 lbs.



STANDARD VISE HEAD

$16.95 PNV303 Sh.Wt. 2 lbs.

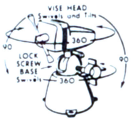
SELF CENTERING 9" WIDE OPENING VISE HEAD

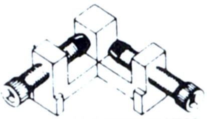


Sh.Wt. 2 lbs.

PNV376 $20.95

PANAVISE TILTS, TURNS, AND ROTATES TO ANY POSITION. IT HOLDS YOUR WORK EXACTLY WHERE YOU WANT IT.



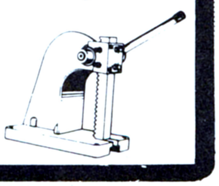


DUAL 90 CORNER CLAMPS

PNV390 $6.95 (pair) 8 oz

PRECISION ¼ TON ARBOR PRESS

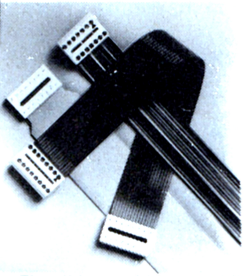
PNV502 $63.95 Sh.Wt. 12 lbs.



CA, AK, HI, CALL (213) 709-5464

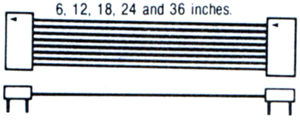
PRIORITY ONE ELECTRONICS

DIP JUMPERS



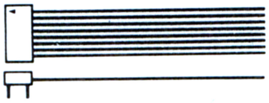
Flat ribbon cable assemblies with molded-on DIP connectors
Available with 14, 16, 14 and 40 contacts

- Mate with standard IC sockets.
- Fully assembled and tested.
- Integral molded-on strain relief.
- Line-by-line probeability.
- Five standard lengths: 6, 12, 18, 24 and 36 inches.



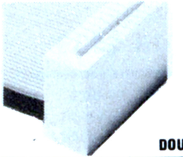
DOUBLE-ENDED ASSEMBLY

Part No.	Description	Price
924106-6	14 Pin, 6" Long	4.70
924106-12	14 Pin, 12" Long	4.90
924106-18	14 Pin, 18" Long	5.10
924106-24	14 Pin, 24" Long	5.30
924106-36	14 Pin, 36" Long	5.70
924116-6	16 Pin, 6" Long	4.90
924116-12	16 Pin, 12" Long	5.15
924116-18	16 Pin, 18" Long	5.40
924116-24	16 Pin, 24" Long	5.65
924116-36	16 Pin, 36" Long	6.15
924126-6	24 Pin, 6" Long	7.75
924126-12	24 Pin, 12" Long	8.15
924126-18	24 Pin, 18" Long	8.55
924126-24	24 Pin, 24" Long	8.95
924126-36	24 Pin, 36" Long	9.75
924136-6	40 Pin, 6" Long	13.25
924136-12	40 Pin, 12" Long	13.90
924136-18	40 Pin, 18" Long	14.55
924136-24	40 Pin, 24" Long	15.20
924136-36	40 Pin, 36" Long	16.50



SINGLE-ENDED ASSEMBLY

Part No.	Description	Price
924102-36	14 Pin, 36" Long	4.20
924112-36	16 Pin, 36" Long	4.60
924122-36	24 Pin, 36" Long	7.50
924132-36	40 Pin, 36" Long	12.30



CARD-EDGE CONNECTOR TERMINATION

Mates with double-sided 1/16" PC board up to 2.050" wide with contact fingers on .100" centers. Probe access holes in back.

DOUBLE-ENDED

Part No.	Description	Price
924052-06	20 Contact, 6" Long	9.95
924053-06	26 Contact, 6" Long	11.20
924054-06	34 Contact, 6" Long	13.90
924055-06	40 Contact, 6" Long	16.20
924056-06	50 Contact, 6" Long	17.55
924150-24	Contact 24" to Socket Connector	12.95

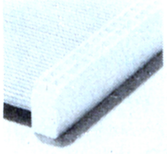
SINGLE-ENDED

Part No.	Description	Price
924062-36	20 Contact, 36" Long	7.80
924063-36	26 Contact, 36" Long	9.35
924064-36	34 Contact, 36" Long	11.75
924065-36	40 Contact, 36" Long	12.90
924066-36	50 Contact, 36" Long	15.65

3-CONNECTOR DAISY CHAIN

Part No.	Description	Price
924092-06	20 Contact, 6" Long	14.90
924093-06	26 Contact, 6" Long	16.70
924094-06	34 Contact, 6" Long	20.70
924095-06	40 Contact, 6" Long	24.30
924096-06	50 Contact, 6" Long	26.31

A P PRODUCTS INCORPORATED



SOCKET CONNECTOR TERMINATION

Mates with two rows of .025" sq. or dia. posts on patterns of .100" centers and shielded receptacles. Probe access holes in back.

DOUBLE-ENDED

Part No.	Description	Price
924002-06	20 Contact, 6" Long	6.15
924002-18	20 Contact, 18" Long	6.65
924002-36	20 Contact, 36" Long	7.40
924003-06	26 Contact, 6" Long	8.20
924003-18	26 Contact, 18" Long	8.80
924003-36	26 Contact, 36" Long	9.70
924004-06	34 Contact, 6" Long	10.55
924004-18	34 Contact, 18" Long	11.35
924004-36	34 Contact, 36" Long	12.55
924005-06	40 Contact, 6" Long	12.05
924005-18	40 Contact, 18" Long	13.05
924005-36	40 Contact, 36" Long	14.55
924006-06	50 Contact, 6" Long	13.50
924006-18	50 Contact, 18" Long	14.70
924006-36	50 Contact, 36" Long	16.50

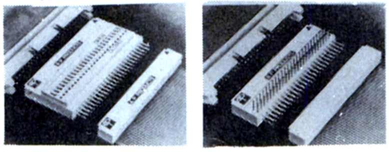
SINGLE-ENDED

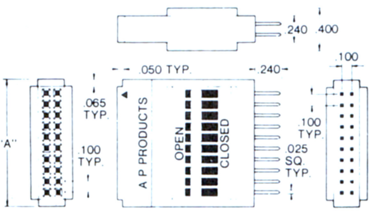
Part No.	Description	Price
924012-36	20 Contact, 36" Long	5.80
924013-36	26 Contact, 36" Long	7.20
924014-36	34 Contact, 36" Long	9.30
924015-36	40 Contact, 36" Long	10.85
924016-36	50 Contact, 36" Long	13.40

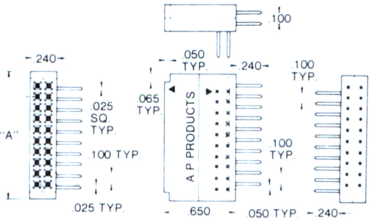
3 CONNECTOR DAISY CHAIN

Part No.	Description	Price
924072-06	20 Contact, 6" Long	8.30
924073-06	26 Contact, 6" Long	10.85
924074-06	34 Contact, 6" Long	14.20
924075-06	40 Contact, 6" Long	16.65
924076-06	50 Contact, 6" Long	20.70

INTRA-CONNECTOR/SWITCH



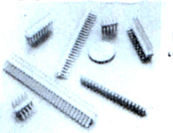




Intra-Connector has pins along its side to allow easy probing of ribbon cable. Provides both straight in and right angle functions. Intra-Switch has integrated switches to allow on/off switching of circuits with ribbon cable. Switches may be actuated with pencil or probe tip. Both mate with standard 0.10" x 0.10" dual-row connectors. Contacts are non-corrosive alloy 770.

Part No.	Model No.	Description	Price
922576-20	IC-20	20 Contact Intra-Connector	$ 6.75
922576-26	IC-26	26 Contact Intra-Connector	7.75
922576-34	IC-34	34 Contact Intra-Connector	9.10
922576-40	IC-40	40 Contact Intra-Connector	10.10
922576-50	IC-50	50 Contact Intra-Connector	11.80
922578-20	IS-20	20 Contact Intra-Switch	13.45
922578-26	IS-26	26 Contact Intra-Switch	15.45
922578-34	IS-34	34 Contact Intra-Switch	18.15
922578-40	IS-40	40 Contact Intra-Switch	20.20
922578-50	IS-50	50 Contact Intra-Switch	23.55

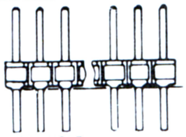
JUMPER HEADERS DOUBLE ROW



IDEAL MATES FOR "GREAT JUMPERS"

MATERIALS: Dielectric is thermoplastic polyester, unaffected by wave soldering or board cleaning solvents. Posts are fabricated from copper alloy.

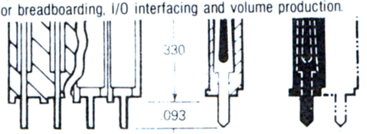
- Solder to PC boards for instant plug-in access via socket-connector jumpers.
- .025" square posts are molded into plastic header strip on a .10" x .10" matrix.
- Choice of straight or right angle configurations.



	No. Posts	Part Number	Price 2 sets
STRAIGHT	20	923862	$1.85
	26	923863	$2.20
	34	923864	$2.75
	40	923865	$3.20
	50	923866	$3.90
RIGHT-ANGLE	20	923872	$2.20
	26	923873	$2.75
	34	923874	$3.45
	40	923875	$4.00
	50	923876	$4.95

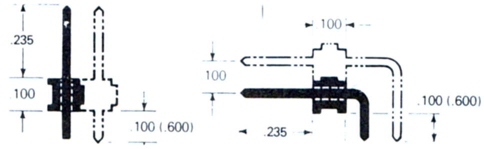
MALE & FEMALE HEADERS

- Designed for matrices of .025" posts on .100" centers.
- 36 contacts per row – molded into rugged nylon header strip.
- May be "cut-to-length" for shorter rows of contacts.
- Single and dual rows available.
- Thermoplastic polyester dielectric with copper alloy 770.
- Ideal for breadboarding, I/O interfacing and volume production.



FEMALE HEADERS

Part No.	Rows	Type	Price
929974	1	Straight	$1.49
929975	2	Straight	$3.09



MALE WIRE WRAPPING MODELS (.600" tail)

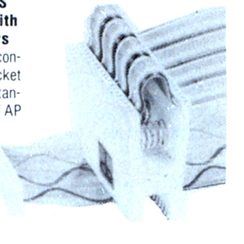
Part No.	Rows	Type	Price
929834-05	1	Straight	$2.29
929836-05	2	Straight	$4.59
929835-03	1	Rt. Angle	$2.09
929838-03	2	Rt. Angle	$4.59

MALE PC BOARD MODELS (.100" tail)

Part No.	Rows	Type	Price
929834-01	1	Straight	$1.09
929836-01	2	Straight	$2.29
929835-01	1	Rt. Angle	$1.29
929838-01	2	Rt. Angle	$2.99

LOGICAL CONNECTIONS
Ideal for interfacing with remote logic analyzers

Test clip termination end consists of pair single-row socket connectors which install in tandem on external test pins of AP IC test clip.



PART NO.	DESCRIPTION	PRICE
923880-40	40 Pin, No Connector	**$33.95**
923881-40	40 Pin, Socket Connector	**$35.95**
923882-40	40 Pin, CardEdge Connector	**$38.20**
923883-40	40 Pin, PCB Connector	**$39.20**
923884-40	40 Pin, DIP Plug	**$36.05**
923880-16	16 Pin, No Connector	**$12.90**
923881-16	16 Pin, Socket Connector	**$14.00**
923882-16	16 Pin, Card-Edge Connector	**$15.10**
923883-16	16 Pin, PCB Connector	**$15.10**
923884-16	16 Pin, DIP Plug	**$14.00**
923880-24	24 Pin, No Connector	**$26.40**
923881-24	24 Pin, Socket Connector	**$27.55**
923882-24	24 Pin, Card-Edge Connector	**$28.65**
923883-24	24 Pin, PCB Connector	**$28.65**
923884-24	24 Pin, DIP Plug	**$27.55**

CALL FOR AP HEADERS NOT LISTED

PRIORITY ONE ELECTRONICS

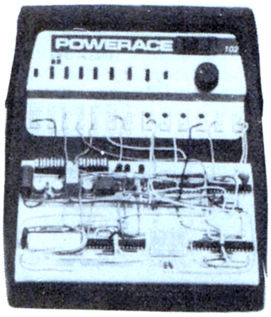
Introducing

POWERACE

Use a POWERACE for faster and easier prototyping of all types of electronic circuits

- 1680 solderless, plug-in tie points will hold up to 18 14-pin DIPs
- Breadboard elements accept all DIP sizes including RTL, DTL, TTL and CMOS devices, TO-5's and discretes with leads up to .032" dia
- All connections to/from switches, indicators, power supplies and meters are made via solderless, plug-in, tie-point blocks on control panels
- Interconnect with any solid 20 to 30 AWG wire
- Breadboard elements are mounted on ground planes ideal for high-frequency and high-speed/low-noise circuits
- Short-circuit-proof fused power supplies
- Operate on 110 to 130 VAC at 60 Hz
- Space-age compact styling and high-grade components permit convenient, organized and quick prototyping

Shipping Weight - 4 lbs



POWERACE 101

POWER SUPPLY is regulated and adjustable from +5 to +15 VDA at 600 mA. Ripple/noise is ≤10 mV at full load. Line and load regulation is ≤3%

METER is built in 0-15 VDC. Inputs are accessible at tie-point blocks on control panel which allows monitoring of power supply or circuits. Meter accuracy is 5% of full scale

923101 **$96.95**

POWERACE 102

POWER SUPPLY is regulated +5 VDC at 1 amp. Ripple/noise is ≤10 mV at full load. Line and load regulation is ≤1%

PULSE DETECTION WITH MEMORY is built in. Will detect positive or negative going pulses as short as 10 nanoseconds. Memory is reset by momentary switch on control panel

THREE LOGIC INDICATORS (LEDs) have buffered inputs that require 1 microamp max.

FREE LOGIC PROBE: The above pulse detection with memory plus logic indicator features constitute a free, built-in logic probe!

TWO LOGIC SWITCHES, momentary, with debounce circuitry. Both Q and Q outputs can sink 15 mA and source 5 mA

FOUR DATA SWITCHES with logic 1 or logic 0 outputs have unlimited sinking capabilities and can source 10 mA

CLOCK GENERATOR has the following frequencies available: 1 Hz, 10 Hz, 100 Hz, 1 KHz, 10 KHz and 100 KHz with a 50% duty cycle. C output will sink 15 mA and source 5mA. C output will sink or source 50 mA

ONE-SHOT PULSE GENERATOR has output of 7 ms pulse, positive or negative going. Both Q and Q outputs can sink 15 mA and source 400 microamps

923102 **$149.95**

POWERACE 103

TRIPLE-OUTPUT POWER SUPPLY has outputs of +5 VDC at 750 mA; +15 VDC at 250 mA; and −15 VDC at 250 mA. Ripple/noise is ≤10 mV at full load for all outputs. Line and load regulation is ≤1% for all outputs. ±15-volt outputs track

METER is built in 15-0-15 VDC. Input is accessible at tie-point block on control panel which allows monitoring power suplies or circuits. Meter accuracy is 5% of full scale

TWO LOGIC INDICATORS (LEDs) have buffered inputs that require 1 microamp max.

TWO LOGIC SWITCHES, momentary, with debounce circuitry. Both Q and Q outputs can sink 15 mA and source 5 mA

TWO DATA SWITCHES with logic 1 and logic 0 outputs have unlimited sinking capabilities and can source 10 mA

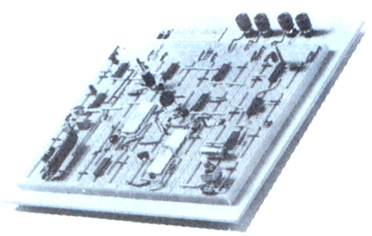
923103 **$149.95**

JUMPER WIRE KIT

- Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0"
- Each wire is stripped and the leads are bent 90° for easy insertion
- Wire length is classified by color coding
- All wire is solid tinned 22 gauge with PVC insulation
- The wires come packed in a convenient plastic box

923351 JK-1 **$13.95**

ALL-CIRCUIT EVALUATORS



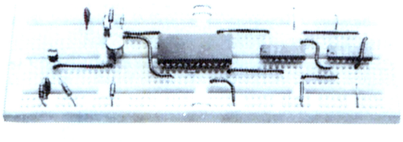
- ACE for fast, solderless, plug in circuit building and testing. Plug in any components with leads up to 0.032" diameter. Interconnect with solid wire up to 20 gauge. Gold-anodized aluminum base/ground. Non corrosive nickel silver terminals. 4 rubber feet

PART NO.	ACE MODEL NO.	DIP CAPACITY	TIE POINTS	NO. BUSES	NO. POSTS	PRICE EACH
923333	200-K (kit)	8	728	2	2	$22.75
923332	208 (assem.)	8	872	8	2	$30.70
923334	201-K (kit)	12	1032	2	2	$29.95
923331	212 (assem.)	12	1224	8	2	$37.05
923326	218 (assem.)	18	1760	10	2	$49.80
923325	227 (assem.)	27	2712	28	4	$63.55
923324	236 (assem.)	36	3648	36	4	$84.75

BREADBOARD II

- 3208 available tie points; numbered I/O buss
- Base is G-10 glass epoxy with ground plane; tie-points are copper alloy 770
- For use with #22 solid wire
- 3 binding posts, 18 busses, size 7" x 9"

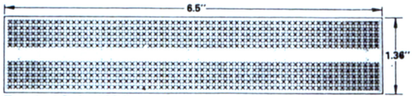
923605 **$141.00**



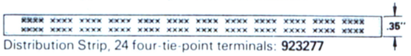
SUPER STRIPS

- Combine power/signal distribution system with universal 10" x 10" matrix of 128 terminals, each with 5 tie points
- 840 solderless, plug-in tie-points
- Accommodates up to nine 14 pin DIPs
- Compatible with all DIPs and discretes with lead diameters to .032"
- Require no special patch cords

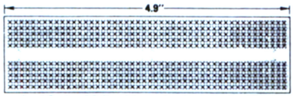
923252	SS2 (Alloy 770 Terminals)	$18.50
923748	SS1 (Gold Plated Terminals)	$33.95



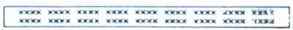
Terminal Strip, 128 five-tie-point terminals: 923261



Distribution Strip, 24 four-tie-point terminals: 923277



Terminal Strip, 96 five-tie-point terminals: 923265



Distribution Strip, 18 four-tie-point terminals: 923281

TERMINAL AND DISTRIBUTION STRIPS

For building custom breadboards. Plug-in matrices on .1 x .1 centers for all DIPs, TO-5s, discretes and solid wire jumper to .032". Includes integral, non-shorting, instant mounting back.

	TERMINAL STRIPS DISTRIB. STRIPS	BUSES, TERM. AND TIE POINTS	PRICE
923265	248L Term. strip	96 5-tie-point term.	$11.20
923261	264L Term. strip	128 5-tie-point term.	$14.00
923291	*154R Term. strip	54 4-tie-point term.	$ 6.75
923289	264R Term. strip	128 4-tie-point term.	$11.20
923281	209R Dist. strip	2 buses of 36 tie pts.	$ 2.80
923277	212R Dist. strip	2 buses of 48 tie pts.	$ 3.50
923293	606R Dist. strip	6 buses of 24 tie pts.	$ 3.95

*Models 154R are single strips of terminals; all other strips are dual-row for DIPs. Gold-plated copper alloy terminals. Height of all strips is .32".

"SUPER-GRIP II" IC TEST CLIPS

- Proven Alloy 770 contacts for optimum wiping action.
- New "narrow-nose" shape allows easy attachment on high-density boards. Fits onto ICs with only .040" between opposing rows of leads.
- New "open-nose" design now permits probe tip access at DIP leads.
- New "duck-bill" contacts are flat - won't roll off new narrow DIP leads.
- "Contact comb" fits between DIP leads - eliminating any possibilities of shorts.
- Steel pin and hinge design. Made to last!
- Heavy-duty, industrial-grade springs for firm contact pressure. They'll keep their spring indefinitely. No intermittents.
- Rugged, engineering-grade thermoplastic body molded around contact pins.
- Offset pin rows allow probes to hang free on longer pins in the top row and not interfere with shorter pins in the bottom row.

STANDARD TEST CLIP

New "nail-head" pins keep probe hooks from sliding off ends.

PART NO.	MODEL NO.	ROW TO ROW SPACING	PRICE
923695	TC-8	.3 in.	$ 7.90
923698	TC-14	.3 in.	$ 4.85
923700	TC-16	.3 in.	$ 5.10
923702	TC-16LSI	.5/6 in.	$ 9.40
923703	TC-18	.3 in.	$10.50
923704	TC-20	.3 in.	$12.15
923705	TC-22	.4 in.	$13.60
923714	TC-24	.5/6 in.	$14.15
923718	TC-28	.5/6/in.	$15.55
923720	TC-36	.5/6 in.	$20.35
923722	TC-40	.5/6 in.	$21.45

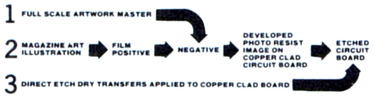
HEADLESS TEST CLIP

Both rows of contacts are the same length (not offset) and do not have "nail-heads".

PART NO.	MODEL NO.	ROW TO ROW SPACING	PRICE
923690-8	LTC-8	.3 in.	$ 7.90
923690-14	LTC-14	.3 in.	$ 4.85
923690-16	LTC-16	.3 in.	$ 5.10
923690-16L	LTC-16LSI	.5/6 in.	$ 9.40
923690-18	LTC-18	.3 in.	$10.50
923690-20	LTC-20	.3 in.	$12.15
923690-22	LTC-22	.4 in.	$13.60
923690-24	LTC-24	.5/6 in.	$14.15
923690-28	LTC-28	.5/6 in.	$15.55
923690-36	LTC-36	.5/6 in.	$20.35
923690-40	LTC-40	.5/6 in.	$21.45

PHOTO ETCH™ PRINTED CIRCUIT KIT

Makes circuits THREE WAYS


1 FULL SCALE ARTWORK MASTER
2 MAGAZINE ART ILLUSTRATION
FILM POSITIVE
NEGATIVE
DEVELOPED PHOTO RESIST IMAGE ON COPPER CLAD CIRCUIT BOARD
ETCHED CIRCUIT BOARD
3 DIRECT ETCH DRY TRANSFERS APPLIED TO COPPER CLAD BOARD

- Copy circuits right from a magazine using special photo film. No camera or darkroom used. Page is not destroyed in process.
- Do your own master art, make negatives, sensitize boards and etch one or a hundred circuits; all identical, all perfect.
- For one-of-a-kind PCs, use special dry transfer patterns as a direct etch resist.
- Do it all with the ER-4.

DATER4	Complete Photo Etch Set	$32.95
DATER2	Assorted Etch Resist Patterns & Tapes	4.95
DATER3	¼lb Dry Ferric Chloride (makes 1 pint)	2.25
DATER5	6 Sheets Copy Film 5" x 6" makes 1 pint)	5.95
DATER6	Film Process Chemicals	2.75
DATER71	Photo Resist Liquid W/Pump Spray Does 1700 in.	6.95
DATER8	Photo Resist Developer, 16 oz	3.50
DATER9	2 Sheets Coy Film*	5.95
DATER10	9" x 12" Steel Exp. Frame W/Filter & Instr.*	12.95
DATER11	2 PC Boards: 5" x 6", 3" x 4½"	2.95
DATER12	Power Etch Bubble Pump Unit*	7.25
DATER3	¼lb Dry Ferric Chloride (makes 1 pint)	2.25
DATER1	Direct Etch Printed Circuit Set*	8.50

***Not included In DATER4 Set**

the **DATAK** corp.

ORDER TOLL FREE (800) 423-5922

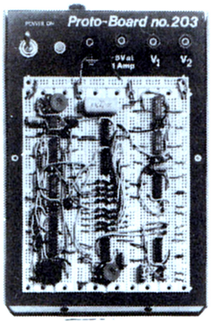
PRIORITY ONE ELECTRONICS

PROTO-BOARD UNITS

All the speed and convenience of QT sockets and Bus Strips plus backplanes and binding posts in both kits and pre-assembled units. Assemble, test and modify circuits as fast as you can think.

Part No.		Dip Capacity	Board Size Inches	Price
GSCPB6	Kit	10(14's)	6x4x¼	**$19.95**
GSCPB100	Kit	10(14's)	4½x6x¼	**21.95**
GSCPB101	ASM	10(14's)	6x4½x¼	**28.95**
GSCPB102	ASM	12(14's)	7¼x4½x¼	**34.95**
GSCPB103	ASM	24(14's)	9x6x¼	**59.95**
GSCPB104	ASM	32(14's)	9⅛x8x¼	**77.00**

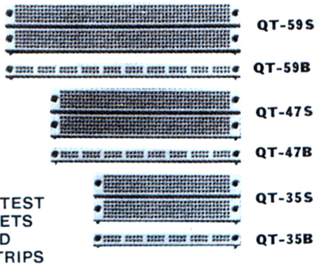
PROTO-BOARD PB-203 - HOLDS 24 14-PIN IC'S



Fully assembled breadboard contains built-in, short-proof, fused, 5VDC at 1 amp, regulated power supply, in addition to three QT-59S sockets, four QT-59B bus strips, one QT-47B bus strip and four binding posts. Capacity for most digital and many analog projects. **SIZE:** 9.75" LG, 6.6" w, 3.25" h. **WEIGHT:** 5 lbs.

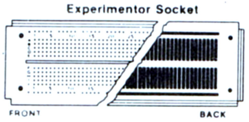
GSCPB203 .... **List Price** $133.00
Our Price **$125.00**
GSCPB203A ... All features plus ±15VDC @ 500mA ... $174.00
Our Price **$160.00**
GSCPB203AK .... Kit version of the 203A $149.95
Our Price **$138.00**

Universal breadboarding system eliminates the soldering iron. QT sockets provide terminals, each consisting of five pre-connected tie-points, running across the width of the socket. QT bus strips consist of two rows of connected tie-points (in groups of five) which run the length of the bus strip.



QUICK TEST SOCKETS AND BUS STRIPS

GSC No.	Length Ins.	Mtg. Dimen., Ins.	I.C. Qty.	Price
		QT SOCKETS		
GSCQT59S	6.5	6.2x0.7	8	**$12.50**
GSCQT47S	5.3	5.0x0.7	6	**10.25**
GSCQT35S	4.1	3.8x0.7	5	**8.50**
		QT BUS STRIPS		
GSCQT59B	6.5	6.2x0.7		**2.99**
GSCQT47B	5.3	5.0x0.7		**2.59**
GSCQT35B	4.1	3.8x0.7		**2.25**



BREADBOARDING SOCKETS

Solderless breadboarding sockets accept DIP's transistors, LED's, resistors, capacitors, and most all types of dicrete components, as well as #22-30 solid hookup wire.

Part No.	Center Channel	I.C. Qty.	Size Inches	Price
GSCEXP300	0.3"	6	⅜x2.1x6	$12.00
GSCEXP350	0.3"	3	⅜x2.1x3.5	6.75
GSCEXP325	0.3"	1	⅜x2.1x1.86	3.50
GSCEXP600	0.6"	3	⅜x2.4x6	14.75
GSCEXP650	0.6"		⅜x2.4x3.6	8.75
GSCEXP4B	Bus Strip	1	⅜x1.0x6.0	4.75
	EXPREMENTER MATCH BOARD			
GSCEXP300P	One Matchboard			2.70
GSCEXP302	(3) 50 Sheet Workpads			3.30
GSCEXP303	(2) Matchboard (1) EXP-300			16.00
GSCEXP304	(2) Matchboard (1) EXP-300 (1) Scratchboard			17.00

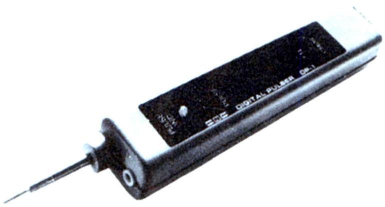
LOGIC PROBES

GSC logic probes are the ultimate tools for digital design and testing. These hand-held units provide an instant overview of circuit conditions. Simple to use: just clip power leads to circuit's power supply, set logic family switch to TTL/DTL or CMOS/HTL. Touch probe to test node. Trace logic events and pulses through digital circuits. Even stretch and latch for easy pulse detection. Instant recognition of high, low or invalid levels, open circuits and nodes. Simple, dual-level detector LED's tell it quickly, correctly. HI (Logic "1"), LO (Logic "0"). Also incorporates blinking pulse detector, e.g., HI and LO LED's blink on or off, tracking "1" or "0" states at square wave frequencies up to 1.5 MHz. Pulse LED blinks during pulse transition. Choice of three models to meet individual requirements: budget, project and speed of logic circuits.

LP-1 LOGIC PROBE—Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL or CMOS. **Input Impedance:** 100,000 Ohms. **Min. Detectable Pulse:** 50 ns. **Max. Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stores
GSCLP1 .... List $50.00 OUR PRICE $45.00

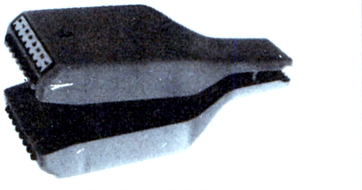
LP-2 LOGIC PROBE—Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. **Input Impedance:** 300,000 Ohms. **Min. Detectable Pulse:** 300 ns. **Max. Input Signal (Frequency):** 1.5 MHz. **Pulse Detector(LED):** High speed train or single event. **Pulse Memory:** none
GSCLP2 .... List $32.00 OUR PRICE $30.00

LP-3 LOGIC PROBE - High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 Ohms. **Minimun Detectable Pulse:** 6 ns. **Max Input Signal (Frequency):** 60 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored
GSCLP3 .... List $77.00 OUR PRICE $69.00



DIGITAL PULSER

The ultimate in speed and ease of operation. Simply connect clip leads to positive and negative power, then touch DP-1's probe to a circuit node; automatic polarity sensor detects circuit's high or low condition. Depress the pushbutton and trigger an opposite polarity pulse into the circuit. Fast troubleshooting includes injecting signals at key points in TTL, DTL, CMOS or other popular circuits. Test with single pulse or 100 pulses per second via built-in dual control pushbutton button selects single shot or continuous modes. LED indicator monitors operating modes by flashing once for single pulse or continuously for a pulse train. Completely automatic, probe-size lab/field pulse generator for any family of digital circuits. **Output:** Tri-state. **Polarity:** Pulse-sensing auto-polarity. **Sync and Source:** 100 mA. **Pulse Train:** 100 pps. **LED Indicator:** Flashes for single pulse; stays lit for pulse train.
GSDCPI .... List $83.00 OUR PRICE $76.00



LOGIC MONITOR

Trace signals through all types of digital circuits. Unit clips over any DIP IC up to 16 pins. Each of its 16 contacts connects to a single bit level detector that drives a high intensity, numbered LED readout activated when the applied voltage exceeds a fixed 2 V threshold. Logic "1" turns LED on; logic "0" keeps LED off. A power-seeking gate networks automatically locates supply leads and feeds then to the LM-1's internal circuitry. Saves minutes, even hours in design troubleshooting, debugging of equipment. **Voltage Threshold:** 2 V ±0.2 V. **Input Impedance:** 100,000 Ohms. **Input Voltage Range:** 4-15 V max. across any two or more inputs. **Current Drain:** 200 mA at 10 V. **Size:** 4" l.x2"w.x1.75" d. when open. **Weight:** 3 ozs.
GSCLM1 .... List $79.00 OUR PRICE $72.00

LOGICAL ANALYSIS KITS

The increasing use and complexity of digital logic has created the need for portable and compact test equipment. The Logical Analysis Kits contain design/test/troubleshooting instruments that detect and locate logic problems as well as component or mechanical failures, down to a specific IC pin. The Logic Pulser (the source) and the Logic Probe or Logic Monitor (detectors) instantly provide static and dynamic logic state analyses. These portable compact units save time in all phases of digital work.

GSCLTC-1 Logical Analysis Kit—Complete with LP-1 logic Probe, DP-1 Logic Pulser, LM-1 Logic Monitor wiring accessories, manuals and molded case........... **OUR PRICE $220.00**
GSCLTC-2 Logical Analysis Kit—For high-speed and memory analysis. Same as Model LTC-1, except substitutes LP-3 High-Speed Logic Probe .... **OUR PRICE $245.00**

ECL LOGIC PROBE

GSCLP4 ECL Logic Probe is the first full-featured logic probe capable of handling the high speeds and narrow threshold differentials of emitter-coupled logic (ECL) circuits. The Model LP-4 detects and indicates valid ECL logic levels using LED indicators for HI (logic 1) and LO (logic 0) levels. A third LED (labeled PULSE) indicates the occurrence of single pulses as short as 3 ns in duration and of pulse trains with repetition rates up to 100 MHz minimum (150 MHz typical at 50% duty cycle). With the PULSE LED on, the HI or LO LEDs indicate positive or negative pulse polarity.

INCLUDES

Instruction manual, LD-8 36" power ground leads with alligator clips, LDA-1 1.5" long probe tip, LDA-5 3" long ground alligator clip, LDA-3 3" long easy hook input adapter, LDA-10 BNC input adapter, LDA-11 3" long wire wrap pin-input adapter, LDA-12 3" long wire wrap pin-ground adapter & case.

GSCLP4 .... **List $150.00**
OUR PRICE $136.00

MAX100 100MHZ FREQUENCY COUNTER

Specifications:

Frequency Range: 20 Hz to 100 MHz guaranteed; 110 MHz typical. **Gate Time:** 1 sec. **Resolution:** 1 Hz. **Accuracy:** ±1 count ± time base error. **Input Impedance:** 1 Megohm shunted by 56pF. **Coupling:** AC. **Sine Wave Sensitivity:** 30 mV RMS at 50 MHz. **Internal Time Base Frequency:** 3.579545 MHz crystal oscillator. **Stability:** ±3 ppm at 25°C. **Temperature Stability:** Better than 0.2ppm/°C, 0-50°C Max. **Aging:** 10 ppm/year. **Display:** Eight 0.6" LED digits. **Lead-Zero Blanking:** Decimal point appears between 6th and 7th digit when input exceeds 1 MHz. **Overflow:** With signals over 99,999,999 Hz, most significant (left hand) digit flashes, allowing readings in excess of 100 MHz. **Display Update:** 1/6 sec. plus 1 sec. gate time. **Low Battery Indicator:** When battery supply falls below 6.6 VDC all digits flash at 1 Hz. **Power Required:** Internal 6 "AA" cells; external, 110 or 220 VAC charger/eliminator, auto cigarette lighter adapter or 7.2-10 VDC external supply. **Battery Charging:** 12-14 hrs. **Size: 1.75"h. x 5.63" 2. x 7.75" d. Weight:** Less than 1.5 lbs. with batteries.

GSCMAX100 Frequency Counter .... List $149.00
OUR PRICE $136.00

MAX-100 ACCESSORIES

GSC100-CA1—100 VAC Charger/eliminator **12.45**
GSC100-IPC—Input cable with clip leads **7.45**
GSCPS-500 Prescaler—500MHz 10:1 .... **70.00**
GSC100-CC—Carrying case **12.45**
GSC MAX50—Frequency Counter ..... List $77.00
6 digit handheld version of MAX100
OUR PRICE $72.00
GSCMMAC2 AC Adapter—For 110 Vac **12.45**
GSCMMA4 Mini Antenna— 4.95
GSCMM-IPC Input Cable Clip Leads— 4.95

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PRIORITY ONE ELECTRONICS

GLOBAL SPECIALITIES TEST EQUIPMENT

6001 FREQUENCY COUNTER

Model 6001 bench-top frequency counter is designed for applications from audio to UHF, in communications, data processing, process control. RF and digital design, multiplex, etc. Exceptional flexibility in general-purpose lab and test-bench applications. Extremely accurate measurements from 50 Hz to 650 MHz. **Inputs (Front Panel):** Two inputs provided through front-panel BNC connectors. "A" input is for signal frequencies from 5 Hz to 100 MHz; 1 Megohm +25 pF input impedance; a low-pass filter provides 3 dB/octave rolloff at 50 KHz. "B" input is for signal frequencies from 40 to 650 MHz; 50 Ohms input impedance; fuse protected. **Gate Times:** Three pushbutton selectable gate times (0.1, 1.0 and 10 sec.) provide resolutions of 10, 1 and 0.1 Hz respectively; a front-panel LED indicates gate-open condition. **Timebase:** A precision 10 MHz crystal oven oscillator (0.5 ppm, 0-50 C) provides internal reference, or an external reference may be selected by a rear-panel switch. The oven oscillator output is buffered and made available at a rear-panel BNC connector. A second rear-panel BNC connector provides the input connection for an external timebase reference signal. Use of an external timebase other than 10 MHz permits the 6001 to operate in a scaling (also called rescaling) mode in which the output is presented in units other than Hz. This permits the 6001 to be used as a directly-duplicating digital display in a number of applications, including transducer translation, flow monitoring, tachometry, etc. **Display:** 8-digit, 7-segments, 0.43" LED display features zero blanking. Decimal point indicates frequency in MHz. A contrast enhancement filter assures legibility, even in high ambient light conditions. Discrete front-panel LEDs provide Oven Ready, Overflow and Gate Open indications. In addition the leftmost digit (of the 8-digit display) flashes to indicate counter overflow. **Controls:** Power Gate Time Select, A/B Input Select. Low Pass Filter In/Out, Intrernal/Externai Time Base (rear-panel). **Power Required:** 105-135 VAC, 57-63 Hz, 10 VA max; 215-250 VAC, 50-60 Hz version available. **Operating Temperature:** 0-50 C. **Size:** 3"h. x 10"w. x 7"d. **Weight:** 3 lbs. SH. WT. 6 lbs.

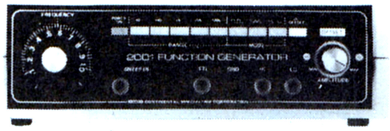
GSC6001—Frequency Counter....... List $489.00

OUR PRICE $445.00

Input Fuse Kit—Includes two miniature 1/10 amp fuses (for B input protection). Net per kit **$7.50**

5001 UNIVERSAL COUNTER-TIMER

Designed for electronic measurements and display of frequency, period, interval and counted events. Unique full input signal conditioning on both channels, including attenuators, slope selection and variable trigger level. Variable delay between measurements. **Frequency:** Up to 10MHz in four ranges. **Selectable Gate Times:** 01, 0.1, 1.0 or 10 seconds. Display indicated frequency (inKHz) at A input. **Period:** Measures period of signal at A input, 400 nsec. to 10 sec.; measures signal cycle or averages over 10, 100 or 1,000 cycles. Display indicates time period. **Frequency Ratio:** Counts number of cycles occurring at A input (to MHz) during one cycle at B input (to 2 MHz) or averages over 10, 100 or 1,000 cycles at B input . Useful for scaling measurements. Display indicates ratio FA/FB. **Time Interval:** Measures time between given signal edge occurring at A input (starts measurement) and given edge occurring at B input (ends measurement) from 200 nsec. to 10 sec. May average over 10, 100 or 1,000 intervals, or measure single interval. **Event Count:** Counts up to 99,999,999 events at up to 10 MHz. "Run" pushbutton enables counting with running count continuous displayed: when "hold" button is pushed displayed count is frozen while counting continues; returns to continuous display when the "Run" button is pushed again. Third ("Reset") button resets count. **Delay:** Variable control causes 75 msec. to 7.5 sec. delay between measurement cycles to facilitate viewing or recording of displayed readings. Detent position freezes display indefinately following next measurement cycle. **Full Signal Conditioning On Both Inputs:** Both inputs incorporate x1/x10/x100 selectable attenuator. + / - slope selcctor and variable trigger level control. Both inputs are 1 Megohm at 25 pF, DC coupled. **Display:** Bright 8-digit, 7-segment, 0.43" LED display, drive for high visibility. Decimal point position gives frequency measurements in KHz, time measurements in micro-seconds. Discrete LED indicators show overflow (when count exceeds 99,999,999) and gate-open conditions. **Operating Temperature:** 0-50 C. **Power Required:** 105-135 VAC. 57-63Hz, 10 VA max.; 215-250 VAC, 50-60 Hz version available. **Size:** 3"h. x 10" w. x 7" d. **Weight:** 3 lbs. SH. WT. 6 lbs.



2001 FUNCTION GENERATOR

Signal generator with advanced IC circuitry produces stable, low-distortion sine waves (less than 2% THD), fast, rise-and-fall-time square waves (less than 100 nsec.), high linearity triangle waves (better than 1%) and TTL square waves with rise and fall time less than 25 nsec. Frequency is accurate, calibrated ±5% and sweepable up to 100:1. A voltage-controlled oscillator allows generator's frequency to be remotely shifted or swept by an AC or a DC voltage fed into the "Sweep In" jacks. A DC voltage provides a directly proportional shift in frequency, while an AC voltage provides a frequency-modulated sweep. Two shortproof, 600-Ohm outputs are adjustable from 1 mV to 100 mV p-p, open circuit and 100 mV to 10 v p-p open circuit, with better than ±5 dB flatness. Variable DC Offset control (push-button selectable) provides controlled, variable shifting of output waveform's center line above or below zero. **Frequency Range:** 1 Hz to 100 KHz in 5 overlapping decade ranges, pushbutton selectable, with a 10:1, 50-increment vernier dial; 1-10 Hz. 10-100 Hz. 100-1000 Hz. 1-10 KHz, 10-100 KHz. **Dial Accuracy:** ±5% of dial setting; calibrated at 10 Hz, 100 Hz, 1 KHz and 10 KHz. **Sine Wave Distortion:** Less than 2% THD over frequency range. **Triangle Wave Linearity:** Better than 1% over frequency range. **Square Wave Rise and Fall Times:** Less than 100 nanosec. with 600 Ohms, 20 pF termination. **Time Symmetry:** Less than ±2%; TTL square wave output with rise and fall times less than 25 nanosec. **Sweep Range:** Maximum 100:1, maximum linear range, 10:1 at any dial setting. **Sweep Input:** 0 to ±10 Volts. **Input Impedance:** 30K Ohms. **Main Output:** Sine square and triangle waveforms, pushbutton selectable; Hi Level, 0.1-10 V p-p open ckt, .05-5 V p-p into 600 Ohms **Amplitude Control:** Variable greater than 40 dB range. **Amplitude Flatness:** Less than ±0.5 dB. **DC Offset Control:** Variable ±5 V into open ckt.; pushbutton in/out switch. **Max. DC Offset: (AC + DC) components before clipping):** Hi output ± 10 V max.; Lo output ±1 V max. **TTL Square Wave Output:** 10 TTL loads, rise and fall time, less than 25 nsec. **Power Required:** 105-125 VAC, 50/60 Hz; 6 Watts; 220-240 VAC, 50/60 Hz optional. **Operating Temperature:** 0° to 50 C (calibrated at 25 C ±5%). **Size: 10"w. x 3"h. x 7"d. Weight:** 2.2 lbs. SH. WT. 6 lbs.

GSC2001 Function Generator........ List $200.00

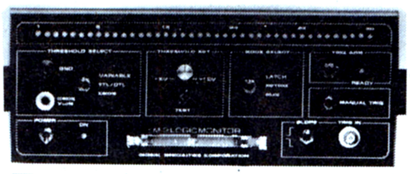
OUR PRICE $185.00

4001 DIGITAL PULSE GENERATOR

A precision digital pulse generator that combines compact size with outstanding performance. Symmetrical and asymmetrical pulses over a wide range of frequencies, duty cycles and amplitudes. Fast rise and fall times; less than 30 nsec. Independent pulse width and spacing controls. Continuous/manual one-shot operation. External triggering; DC to 10 MHz. Synchronous output gating. Square wave and complementary output. In the Gate mode, output is synchronized with leading edge of input gate signal; last output pulse is always completed, even in absence of gate signal. **Frequency Range:** 0.5 Hz to 5 MHz. **Pulse Width and Spacing Controls:** 100 nsec. to 1 sec. in 7 overlapping decade ranges. **Variable Width and Spacing Controls:** Concentric, single-turn verniers provide continuous adjustment between ranges; pulse spacing controls not active during Trigger Gate and One-Shot modes. **Duty Cycle:** 10^7 to 1 range, continuously adjustable. 0.5 Hz to 5 MHz. **Accuracy:** ±5% of control settings; calibrated at min. and max. of vernier settings. **Pulse Jitter:** Less than .1% ±50 ps. **Run Mode:** 0.5 Hz to 5 MHz frequency selectable through pulse width and spacing controls. **Trigger Mode:** DC to approx. 10 MHz from external source. **Gate Mode:** Generator starts synchronously with leading edge of gate signal. **One-Shot Mode:** Momentary pushbutton for single-pulse operation; pulse occurs each time button is depressed. **Square Wave:** Pushbutton provides square wave at output. **Complement:** COMPL pushbutton inverts output signal without losing sync time reference. **TRIG/GATE Input Requirements:** TTL compatible; sine waves, 4 V p-p pulses, 2 V peak, greater than 40 nsec. wide; input impedance, approx. 400 Ohms, DC coupled; max. input level, ±10 V. **VAROUT:** Amplitude, 0.1-10 V into open circuit, adjustable by single-turn vernier; rise/fall time, less than 30 nsec.; impedance, constant 50 Ohms. **TTL OUT:** Fan out, 40 TTL loads; sink, 64 mA at 0.8 V max.; rise/fall time, less than 20 nsec.; pulse width greater than 20 nsec.; sync pulse lead time , greater than 20 nsec. **Operating Temperature:** 0° to 50°C (calibrated at 25°C ±5°C). **Power Required:** 105-125 VAC 50/60 Hz Watts; 220-240 VAC, 50/60 Hz optional **Size:** 10"w. x 3"h. x 7"d. **WT:** 2.2 lbs. SH. WT. 6 lbs.

GSC4001 Digital Pulse Generator.... List $235.00

OUR PRICE $215.00



LM-3 TRIGGERABLE LOGIC MONITOR

LIST PRICE
$699.00

OUR PRICE
$640.00

ORDER PART # GSC-LM3

- Four modes; Run — follows data, Retrig — retrig latches on each trigger, Latch — latch on first trigger only, Manual — manual pushbutton latch.
- Slectable threshold: fixed DTL/TTL, variable — 5 to + 10 Volts, CMOS 70% of sampled V cc.
- Monitor up to 40 logic points simultaneously.
- High input impedance — .5 Meg Ohm @ 6 pf
- 5MHz speed, capture 100 nsec events
- Work with all logic families: DTL, TTL, RTL, PMOS, NMOS, CMOS, ECL, HiNIL, HTL....

Specifications

MAIN INPUTS

40 channels through front panel connector 24" mating ribbon cable and 40 "easy-clips", DC coupled. Input Voltage ± 18V max **Impedance** 0.5 MegOhm @ 6 pF , connector, 0.5 MegOhm = 30 pF with cable **Response** Minimum pulse width 100 nsec; maximum trigger frequency 5 MHz **Sensitivity** DC turn-on threshold Voltage adjustable — 5 to 10 VDC (see Reference spec below)

TRIG INPUT

Single input front panel BNC; switch selects + /-edge; threshold identical to and tracks with main inputs.

Vcc INPUT

Samples Vcc of circuit under test through front panel dual banana jacks.

OUTPUT

Threshold Voltage test point, accepts Voltmeter probe, represents internal threshold Voltage within ±2%.

THRESHOLD REFERENCES

Threshold Voltage for the 40 input channels and the Trigger input are determined as follows for the various settings of the Threshold Mode selector: **TTL** Preset to 2.2 ± 0.1 VDC, any single channel may vary ±200 mV from reference **CMOS** Vcc Input samples Voltage of circuit under test, threshold is determined as 70% of Vcc **Variable** Front panel Variabel Threshold control adjusts threshold over continuous — 5 VDC to + 10 VDC range.

MODES

3 operating modes are available and are selected by Mode switch **Run** Data display follows input date; Ready LED is lighted; data display follows input data until either pulse transition appears at Trigger input or Manual pushbutton is pressed, which freezes data display, turns off Ready LED; data display is updated with new data on each subsequent Trigger pulse or Manual event, data must be stable minimum 20 nsec before and 80 nsec after specified Trigger edge.

Latch Ready LED is lighted; data display follows input data until next Trigger edge or Manual pushbutton Trigger occurs, which freezes data, turns off Ready LED; all further Manual, Trigger inputs ignored until Arm pushbutton is pressed again; data must be stable minimum 20 nsec before and 80 nsec after specified Trigger edge.

CONTROLS

Power, Threshold Select, Variable Threshold, Trigger Slope Select, Mode Select, Arm pushbutton, Manual Trigger pushbutton.

DISPLAY

40 discrete LEDs legend indexed to input connector input channels; LEDs in positions 8, 16, 24, 32, 40 are green, all others red; discrete red LED serves as POWER pilot and latch Ready indicators.

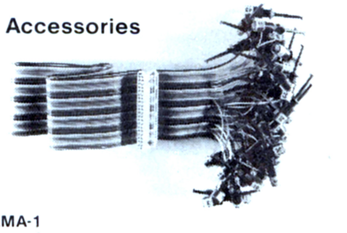
POWER

105-135 VAC 57-63 Hz, 50 VA maximum

WEIGHT: 8 lbs

GSC-LM3M MANUAL FOR LM3 .... **$10.00**

Accessories



GSC-LMA-1

Input Ribbon Cable with easy-clips. 40-conductor ribbon cable, 24 inches (607 mm) long terminated on one end with forty coded easy-clips, on the other with a dual inline socket with goldplated beryllium copper contacts keyed to fit the input connector of the LM-3. **PRICE**

GSC-LMA-1 $132.00

GSC-LAM-2

VCC Sense Input Cable 18 inch (457 mm) long cable, terminated with polarized dual banana plugs at one end, red and black vinyl alligator clips at the other.

PRICE

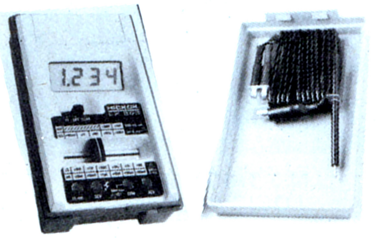
GSC-LMA-2 $4.95

WE ACCEPT VISA, and MASTER CARD

PRIORITY ONE ELECTRONICS

ONE

HICKOK



Here are the truly inexpensive, no nonsense, high performance multimeters you've been looking for! Hickok LX Series DVOM's are as light weight and compact as a VOM . . . but far more accurate, and much easier to read! You can tell at a glance exactly what the reading is.

And you don't have to baby them. LX Series DVOM's are rugged and reliable with excellent overload characteristics handsomely packaged in a high impact thermoplastic case. No delicate needles to worry about. An LX Series DVOM is built to take it . . . so you can take it with you wherever you go.

LX Series DVOM's. All the super-durable, high quality professional meter you need for service and maintenance work at an analog price. So, why pay as much for analog inaccuracy? Or more for digital frills?

SPECIFICATIONS:

	LX303	LX 304
DC VOLTS	200mV, 2V, 20V, 200V, 1000V	
Resolution	100μV on 200 mV range	
Accuracy	±0.9% + 1 digit	±0.5% + 1 digit
Input Impedance	10MΩ, all ranges	
Overload Protection	1000V dc/peak ac, except 500V 200mV range	
RESISTANCE	200Ω, 2KΩ, 20Ω, 200KΩ, 2MΩ, 20,Ω	
Resolution	0.1Ω on 200Ω range	
Accuracy	±0.9% + 1 digit, except ± 1.4% + *1 digit on 20MΩ* range	
Test Voltage	0.35V max. at full scale, 0.5V max. open circuit	
Overload Protection	120V dc or rms ac, all ranges, indefinitely 240V dc or rms ac, all ranges, 30 seconds	
DIODE TEST	Not Available	20KΩ range
AC VOLTS	200V, 600V, Avg. sensing — rms calibrated sine wave	
Resolution	0.1V on 200V range	
SAccuracy	±1.0% + 4 digits, 40 Hz to 120 Hz -0.2 dB @ 1 KHz, - 2.0 dB @ 5KHz	
Input Impedance	4.3MΩ, all ranges	
Overload Protection	600V dc or ac rms, all ranges	
DC CURRENT	20nA, 200nA, 2μA 200μA, 200μA,	200mA, 1A 200mA
Resolution	0.01nA	0.1mA
Accuracy	±1.5% + 1 digit, all ranges except ±2.5% + 1 digit on 200mA range of LX 303	
Overload protection	80V on 20nA to 20μA ranges, 25mA in 200μA, 500mA on 200mA ranges	1.7A all ranges
GENERAL		
Decimal Point	Fixed, all ranges	Automatically located
Power	Single 9V battery; NEDA 1604 (not incl.) or Hickok AC Adapter	
Battery Indicator	Rear panel test point	"Lo Bat" on display
Max. Com. Mode V	500V dc or rms ac	
Dimensions	5⅞" x 3⅜" x 1¾" (14.7 cm x 8.5 cm x 4.3 cm) Weight: 12 Oz.	

PART NO.	DESCRIPTION	PRICE
HICLX303	Multimeter	**$89.95**
HICLX304	Multimeter, Diode Test	**$99.95**
HICRC-3	115V Ac Adapter	**$9.00**
HICCC-3	Padded Carry Case	**$9.00**
HICVP-10	X10 DC Probe Adapter (Up to 10KV)	**$18.95**
HICVP40	40kV DC Probe	**$50.00**
HICCS-1	10 Amp DC Current Shunt	**$18.95**
HICTP-20F	Temp Probe (-67 to 302F)	**$55.00**
HICTP-20C	Temp Probe (-55 to + 150C)	**$55.00**

1.980
HICKOK MX-333

DMM+VARI-PITCH+LOGI-TRAK=MX333
World's fastest troubleshooter

A DMM SO UNIQUE ... SO VERSATILE ... SO SUPERIOR WE WERE TEMPTED TO CALL IT SOMETHING ELSE

We believe the MX333, with the VARI-PITCH× and LOGI-TRAK× functions, to be the greatest time saving tool in electronics today. It has all the functions, ranges and accuracy you expect from the best along with the two additional features which will save enormous amounts of troubleshooting time. And the MX333's 20 ohms range gives you 20 milliohm resolution for those critical low resistance tests. Both MX series DMM's have 0.1% basic accuracy plus a 10A range, plus the intelligent case styling that has the size of a hand held, but the shape of a better idea.

EXCLUSIVE VARI-PITCH

Not just a beep . . . not just instant ohms. MX333's VARI-PITCH audible tone changes frequency proportionate to the reading so you can literally troubleshoot by ear! The higher the pitch, the higher the reading. No need to take your eyes off the probe or wait for a readout to settle. VARI-PITCH responds instantly, proportionally and accurately in all voltage, current, resistant and diode test ranges. It even provides analog-like audible response to variations for quick and easy adjustments and nulling.

FAST LOGI-TRAK (5 nsec fast)

Combines the features of a high performance logic probe and voltmeter in one convenient function. Use any standard 10:1 high frequency scope probe to find high and low logic levels and positive or negative pulses as narrow as 5 nsec without taking your eyes off the circuit! The VARI-PITCH output tells it all. **And,** unlike ordinary logic probes, LOGI-TRAK spots ground shorts, supply shorts, opens, marginal or ambiguous logic states and infrequent pulses instantly! Then, without changing anything but the direction of your glance, it's easy to verify actual voltage on the digital readout!

CONDENSED SPECIFICATIONS:
MX331 and MX333

DC VOLTS (5 RANGES): 220mV to 100V fullscale, RESOLUTION: 0.1mV ACCURACY: ±*0.1%* + 1 digit INPUT IMPEDANCE: 10MΩ OVERLOAD PROTECTION: 1000VDC or peak AC + up to 6kV transients all ranges.

AC VOLTS (5 RANGES): 200mV to 1000V full scale, RESOLUTION: 0.1 mV, ACCURACY: ±*1%* + 2 digits, 45Hz to 1 KHz, ±5% + 5 digits to 5KHz, INPUT IMPEDANCE: 10MΩ, OVERLOAD PROTECTION: 1000V DC/750 RMS.

RESISTANCE (7 RANGES): 20Ω to 20MΩ full scale except no 20Ω range on MX331, RESOLUTION: 0.01Ω on MX333, 0.1Ω on MX331, ACCURACY: 0.1% + 1 digit except 0.2% on 200Ω 1% on 20MΩ and 3% on 20Ω ranges. OVERLOAD PROTECTION: 500V DC on RMS all ranges plus 2A fuse on 20Ω range. TEST VOLTAGE: (low power, 0.25V max of full scale.

DIODE TEST (1 RANGE): Measure forward voltage drop across diode and transistor junctions at 2mA nominal current.

AC/DC CURRENT (5 RANGES): 2mA to 10A fullscale, RESOLUTION: 1 μA, ACCURACY: ±1.2% + 1 digit DC, ±2.5% + 1 digit AC, OVERLOAD PROTECTION: 250V @ 2A ranges except 10A, max 15A on 10A range.

GENERAL: Dimensions: 2.2 x 6.7 x 6 in. (5.6 x 17 x 15.2cm); Weight: 22ox. (.7kg); Power 9V battery (incl.) or Hickok AC adapter.

HICMX331	DMM	**$199.00**
HICMX333	DM w/VARI-PITCH OF LOGI-TRAK	**$265.00**
NLS41141	10:1 Probe for LOGI-TRAK	**$30.00**
HICCC4	Carrying Case	**$15.00**
HICRC3	AC Adapter	**$9.00**
HICVD14	RF Probe	$38.75

FLUKE

DMM ACCESSORIES

FLU Y8205	Carrying case (FLU-D810, D811)	**$35.00**
FLU C90	Carrying case (FLU-D800, D802, D804)	**$10.00**
FLU A81	AC adaptor (FLU-D800, D802, D804)	**$15.00**
FLU 80J10	10 Amp current shunt	**$30.00**
FLU Y8133	Deluxe test lead set	**$18.00**
FLU Y8134	Deluxe test lead set with safety connectors	**$18.00**
FLU Y8140	Slim test lead set	**$18.00**
FLU 80T150C	Temp. probe (C)	**$120.00**
FLU 80T150F	Temp. probe (F)	**$120.00**
FLU Y8102	Sheath thermocoule (D804)	**$50.00**
FLU Y8103	Bead thermocouple (D804)	**$20.00**
FLU Y8104	Thermocouple termination (D804)	**$10.00**
FLU Y8008	Touch and hold probe (D810, D811)	**$45.00**
FLU 80K40	40KV high voltage probe	**$80.00**
FLU 81RF	100 MHz rf probe	**$45.00**
FLU 82RF	500 MHz rf probe	**$85.00**
FLU 801600	Clamp-on AC current probe 600A	**$95.00**
FLU Y8100	200A AC/DC current probe	**$195.00**
FLU Y8101	150A AC current xformer	**$75.00**

FLUKE®

MODEL 804:

- Nine functions
  - dc voltage
  - ac voltage
  - dc current
  - ac current
  - resistance
  - diode test
  - conductance (1/R)
  - logic level and continuity detect
  - temperature (K-type thermocouple)
- Peak hold on voltage and current functions
- Selectable audible indicator for continuity or level detection
- 3½-digit resolution
- 0.1% basic accuracy
- LCD display
- Overload protection
- Safety designed test leads
- Full year parts & labor warranty

-12.34
FLUKE D 804 MULTIMETER

FLUD804A **$249.00**

12.34
FLUKE D 802 MULTIMETER

MODEL 802:

- Seven functions
  - dc voltage
  - ac voltage
  - dc current
  - ac current
  - resistance
  - diode test
  - conductance (1/R)
- 3½-digit resolution
- 0.1% basic dc accuracy
- Overload protection
- Safety-designed test leads
- Full year parts & labor warranty

FLUD802A **$189.00**

12.34
FLUKE D 800 MULTIMETER

MODEL 800:

- Six functions
  - dc voltage
  - ac voltage
  - dc current
  - ac current
  - resistance
  - diode test
- 3½-digit resolution
- 0.5% basic dc accuracy
- LCD display
- Overload protection
- Safety-designed test leads
- Full year parts & labor warranty

FLUD800A **$125.00**

ORDER TOLL FREE (800) 423-5922

PRIORITY ONE ELECTRONICS

FLUKE LOW COST DMM'S FOR BENCH OR FIELD FLUKE

D/804/D802/D800 specifications

Accuracies are ± (% of reading + no. of digits) 1 yr, 18°C to 28°C exc as noted

DC VOLTAGE	**D 804**	**D 802**	**D 800**
Ranges	200 mV, 2V, 20V, 200V, 1000V		
Accuracy (all ranges)	0.1% rdg + 1 dig.	0.1% rdg + 1 dig.	0.5% rdg + dig.
Input Impedance	10MΩ all ranges		
Normal Mode Rej.	>60 dB at 50 and 60 Hz		
Common Mode Rej.	>100 dB at dc, 50, 60 Hz: 1 kΩ unbalance		
Overload	1000V dc or peak ac all ranges exc 200 mV (15 sec. max above 300V)	1000V dc or peak ac on all ranges	1000V dc or peak ac on all ranges
AC VOLTAGE	**D 804**	**D 802**	**D 800**
Ranges	200 mV, 2V, 20V, 200V, 750V		
Accuracy	45 Hz to 1 KHz: 0.75% of rdg + 2 digits on all ranges exc 750V (1% of rdg + 2 digits) 1 KHz to 2 KHz: 1.5% of rdg + 3 digits on all ranges exc 750V (not specified) 2 KHz to 5 KHz: 5% of rdg + 5 digits on all ranges exc 200V and 750V (not specified)		45 Hz to 450 Hz: 1% of rdg + 3 digits on all ranges
Conversion Type	Average sensing, calibrated to read rms of sine wave		
Input Impedance	*10*Ω, <100 pF all ranges		
Common Mode Rej	>60 dB at 50 Hz, 60 Hz, 1 kΩ unbalance		
Overload	1000V dc or 750 rms on all ranges exc 200 mV ac range (15 sec maximum above 300V rms)		
RESISTANCE	**D 804**	**D 802**	**D 800**
Ranges	200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ		
Accuracy			
200 Ω range	0.2% rgd + 3 dig	0.2% rdg + 3 dig	0.3% rdg + 3 dig
2 kΩ thru 200 kΩ	0.1% rdg + 1 dig	0.1% rdg + 1 dig	0.2% rdg + 1 dig
2000 kΩ range	0.2% rdg + 1 dig	0.2% rdg + 1 dig	0.2% rdg + 1 dig
20 MΩ range	2% rdg + 1 dig	2 % rdg + 1 dig	2% rdg + 1 dig
Open Ckt Voltage	<1.5V on all ranges except 2 kΩ range <3.5V		
Diode Test	2 kΩ, 200 kΩ, and 20 MΩ ranges supply enough voltage to turn on junctions allowing a "Diode Test."		
Overload	500V dc or rms on all ranges		
DC CURRENT	**D 804**	**D 802**	**D 800**
Ranges	2 mA, 20 mA, 200 mA, 2000 mA		
Accuracy	1% of rdg + 1 digit all ranges		
Burden Voltage	0.25V max on all ranges except 2000 mA (0.9V max)		
Overload	2A, 250V fuse in series with 3A, 600V fuse		
AC CURRENT	**D 804**	**D 802**	**D 800**
Ranges	2 mA, 20 mA, 200 mA, 2000 mA		
Accuracy			
2 mA range (45 Hz-450 Hz)	3% of rdg + 2 dig	3% of rdg + 2 dig	3% of rdg + 3 dig
20-2000 mA (45 Hz-450 Hz)	3% of rdg + 2 dig	3% of rdg + 2 dig	3% of rdg + 3 dig
(450 Hz-1 KHz)	3% of rdg + 2 dig	3% of rdg + 2 dig	Not Specified
Burden Voltage	0.25V .ax all ranges exc 2000 mA (0.9V max)		
Overload	2A, 250V fuse in series with 3A, 600V fuse		
CONDUCTANCE*	**D 804**	**D 802**	
Ranges	200 ns	2 mS, 200 nS	
Equiv. Resistance	5 MΩ to 10,000MΩ	500Ω to 1 MΩ (2 mS) 5MΩ-10,000 MΩ (200 nS)	
Accuracy	200 nS 2% rdg + 10 dig	200 ns: 2% rdg + 10 dig 2 ms: 0.2% rdg + 1 dig	
Overload	500 V dc or rms all ranges		

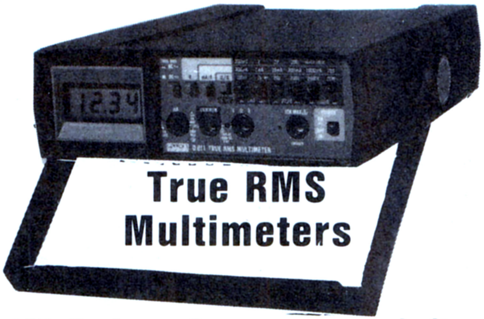
**Conductance is the inverse of ohms (1/Ω) and is expressed in siemens (S).2 mS range (D 802 only) can be used to measure transistor current gain. 200 nS range allows measurement of very high resistance and leakage.*

Level Detector (D804 Only) Use for Active Circuit Testing

Continuity (D 804 Only) Use for Passive Circuit Testing

GENERAL

Maximum Common Mode Voltage: 500V dc or rms
Display: 3½ digit LCD (1999 count), autozero, autopolarity
Temperature: 0°C to 50°C, operating; -35°C to +60°C, storage
Humidity: 0 to 80%, 0°C to 35°C; 0 to 70%, 35°C to 50°C
Temperature Coefficient: (18°C to 0°, or 28° to 50°C) ≳0.15 x the applicable accuracy spec, per °C except D 804 Temp function (≳0.02 x accuracy per °C).
Shock and Vibration: Per MIL-T-28800B
Power: Single 9V battery, NEDA 1604
Battery Life: D 802 and D 800, 200 hrs; D 804, 100 hrs. (typ for alkaline)
Battery Indicator: "BT" lights when approx. 20% of life remains.
Size: 18.0 cm L x 8.6 cm W x 4.5 cm H (7.1 in L x 3.4 in W x 1.8 in H)
Weight: D 802, D 800, 0.37 kg (13 ox); D 804 0.48 kg (17 oz)



● 3½ LCD display ● Auto zero, auto polarity ● AC or battery operated models ● One year warranty ● Many other features not found in other DMM'S!

FLUD810	AC Powered	**$269.00**
FLUD811	AC Powered (with Ni Cad batteries)	**$309.00**

D810/D811 specifications

Electrical specifications for both models are identical except for input power. All accuracy specifications are for 1 year, 18°C to 28°C.

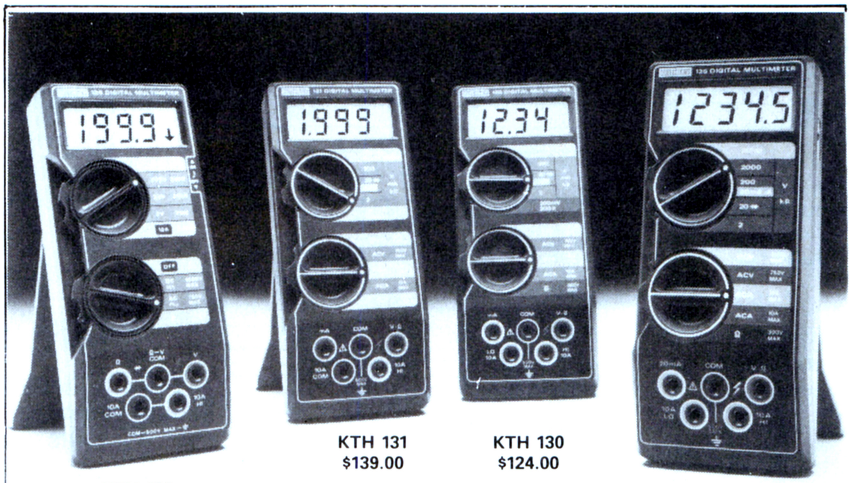
DC VOLTAGE			
Ranges	±200 mV, ±2V, ±0V, ±200V, ±1000V		
Accuracy	±(0.1% of reading + 1 digit) all ranges		
Overload	1000V dc or peak ac on any range		
Input Impedance	10 MΩ all ranges		
Normal Mode Rej	>60 dB at 60 Hz or 50 Hz		
Common Mode Rej	>90 dB at dc, 50 Hz, and 60 Hz		
AC VOLTAGE (True RMS, AC Coupled)			
Ranges	200 mV, 2V, 20V, 200V, 750V		
Accuracy			
200 mV thru 200V	(accuracy applies from 5% to 100% of range) 45 Hz - 10 KHz: 0.5% + 2 digits 10 KHz - 20 KHz: 1% + 2 digits 20 KHz - 50 KHz: 5% + 3 digits		
750V range	45 Hz - 1 KHz: 0.5% + 2 digits		
Overload	750V rms, 1000V peak, not to exceed 10^7 volt-Hz product, (exc 10 sec. max on 200 mV and 2V ranges)		
Input Impedance	10 MΩ in parallel with <100 pF.		
Common Mode Rej	>60 dB at 60 Hz 1kΩ unbalance		
Crest Factor	Waveforms with peak/rms ratio of 1:1 to 3:1		
RESISTANCE			
Range	**Accuracy**	**Overload**	**Open Ckt Voltage**
200Ω, 2k, 20k, 200k **2000k, 20M**	±(0.2% of reading + 1 digit) ±(0.5% of reading + 1 digit)	500V dc or rms all ranges	<3.5V all ranges
Diode Test	2 kΩ, 200 kΩ, 20MΩ ranges can forward bias diode junction.		
CONDUCTANCE (Use for measuring high resistance)			
Range	**Equiv. Resistance**		
2 mS	500Ω to 1 MΩ	±(0.4% of rdg + 1 dig	500V dc or rms all ranges
20 μS	50 kΩ to 100 MΩ	±(0.4% of rdg + 1 dig)	
200 nS	5 MΩ to 10,000 MΩ	±(1.0% of rdg + 10 dig)	
DC CURRENT			
Ranges	200 μA, 2 mA, 20 mA, 200 mA, 2A and 10A		
Accuracy	±(0.3% of rdg + 1 dig) exc 10A ±(0.5%of rdg + 1 dig)		
Overload	2A, 250V fuse in series 3/3A, 600V fuse; exc 10A unfused		
Burden Voltage	0.3V max all ranges exc 2A, 0.9V and 10A, 0.5V		
AC CURRENT (True RMS, AC Coupled)			
Ranges	200 μA, 2 mA, 20 mA, 200 mA, 2A and 10A		
Accuracy			
200 μA thru 200 mA	(accuracy applies from 5% to 100% of range) 45 Hz - 10 KHz: 1.0%+2 digits 10 KHz - 20 KHz: 2.0%+2 digits		
2A and 10A	45 Hz - 2 KHz: 1.0%+2 digits		
Crest Factor	Waveforms with peak/rms ratio of 1:1 to 3:1		
Overld & Burden	Same as for dc current		

CA, AK, HI, CALL (213) 709-5464

KEITHLEY

Handheld DMMs for every application and budget.

- Rugged, easy to use
- Large 0.6" LCD displays
- Choice of 3½-digit, 4½-digit, beeper



KTH 128
$139.00

KTH 131
$139.00

KTH 130
$124.00

KTH 135
$235.00

Analog alternatives/130/131. The Model 130 is a rugged, hard working handheld DMM designed to replace and outperform your old analog unit. Like all Keithley handhelds, it features a large (0.6") LCD, easy-to-use rotary switches, externally accessible battery and fuse and shock-mounted PC board, all in a tough 0.1" ABS plastic case.

The 130 offers ±0.5% DCV accuracy and five full functions that are easy to use. It has 10MΩ input impedance, diode check capability, auto polarity and current measurements through 10A. Yet the 130 is price competitive with quality analog meters. **$124.00**

The 131 offers all the performance features of the 130, and adds the benefits of increased (0.25%) accuracy and enhanced bandwidth on the top ACV ranges. **$139.00**

The sound choice/128. A smart choice for field service, the Model 128 beeper DMM is designed for the real world of hard knocks. The see/hear display includes both over/under threshold indicator arrows on the display and audible tone that may be switched on or off. The 128's beeper operates on all ranges and functions, and the threshold is adjustable to suit various applications. Use the 128 for continuity checks, logic levels or hot tests — it's loaded with practical capabilities, not expensive frills. **$139.00**

The 4½ handheld/135. Our Model 135 offers bench meter sophistication in a compact configuration. It is both the most precise handheld DMM on the market and the lowest priced industrial grade 4½ available today. Compared to ordinary handhelds, the 135 has 3 to 4 times better accuracy and 10 times better resolution. Yet it's a rugged unit, designed for years of service in the field or on the bench. And it's an unbeatable value. **$235.00**

DMM ACCESSORIES

KTH 1301: Temperature Probe (−55° to +150°C)	$89.00
KTH 1304: Soft Carrying Case & Stand (handhelds)	$10.00
KTH 1306: Deluxe Carrying Case (handhelds)	$25.00
KTH 1600A: High Voltage Probe (40kV)	$79.00
KTH 1651: 50-Ampere Shunt	$50.00
KTH 1682A: RF Probe (250MHz)	$79.00
KTH 1685: Clamp-On AC Probe (200A)	$80.00
KTH 1691: General Purpose Test Lead Set	$ 6.00
KTH 1766: AC Power Supply (Models 169 & 176)	$40.00
KTH 1793: IEEE-488 Interface (Model 179-20A)	$325.00

	KTH 128	KTH 130	KTH 131	KTH 135
Digits	3½	3½	3½	4½
DC VOLTS				
Sensitivity	1mV	100μV	100μV	100μV
Maximum Reading	1000V	1000V	1000V	1000V
Basic Accuracy ±(%rdg + digits)	0.5% + 1	0.5% + 1	0.25% + 1	0.05% + 1
Input Impedance	10MΩ	10MΩ	10MΩ	10MΩ
Overload Protection	1000V	1000V	1000V	1000V
NMRR	> 46dB	> 46dB	> 46dB	> 60dB
CMRR	> 100dB	> 100dB	> 100dB	> 120dB
AC VOLTS				
Method	Average	Average	Average	Average
Sensitivity	1mV	100μV	100μV	100μV
Maximum Reading	750V	750V	750V	750V
Basic Accuracy ±(%rdg + digits)	(45-500Hz) 1.0% + 5	(45-120Hz) 1.0% + 5 (500Hz up to 20V)	(45-500Hz) 1.0% + 3	(45-500Hz) 1.0% + 15 (45-20kHz, 2V range)
Input Impedance	10MΩ < 100pF	10MΩ < 100pF	10MΩ < 100pF	10MΩ < 100pF
Overload Protection	750V	750V	750V	750V
OHMS				
Special Features	Diode test. Audible continuity.	Diode test.	Diode test.	Diode test.
Sensitivity	100mΩ	100mΩ	100mΩ	100mΩ
Maximum Reading	20MΩ	20MΩ	20MΩ	20MΩ
Basic Accuracy ±(%rdg + digits)	0.5% + 1	0.5% + 1	0.2% + 1	0.25% + 2
Open Circuit Voltage	3.2V	1.5V	1.5V	3.5V
Overload Protection	300V	300V	300V	300V

	KTH 128	KTH 130	KTH 131	KTH 135
AC/DC AMPS				
Sensitivity	10mA	1μA	1μA	10μA
Maximum Reading	10A	10A	10A	10A
Basic Accuracy ±(%rdg + digits) AC DC	2.0% + 5 1.5% + 1	2.0% + 5 1.0% + 1	2.0% + 2 0.75% + 1	1.5% + 5 0.5% + 2
GENERAL				
Battery Life (alkaline)	350 hr.	200 hr.	200 hr.	100 hr.
Environment	**Operating:** 0°C to 50°C. **Storage:** −35°C to +60°C			
Dimensions	7.0" long × 3.1" wide × 1.5" thick (178mm × 78mm × 38mm)			
Weight	11 oz. (300gm)	10 oz. (282gm)	10 oz. (282gm)	10 oz. (282gm)

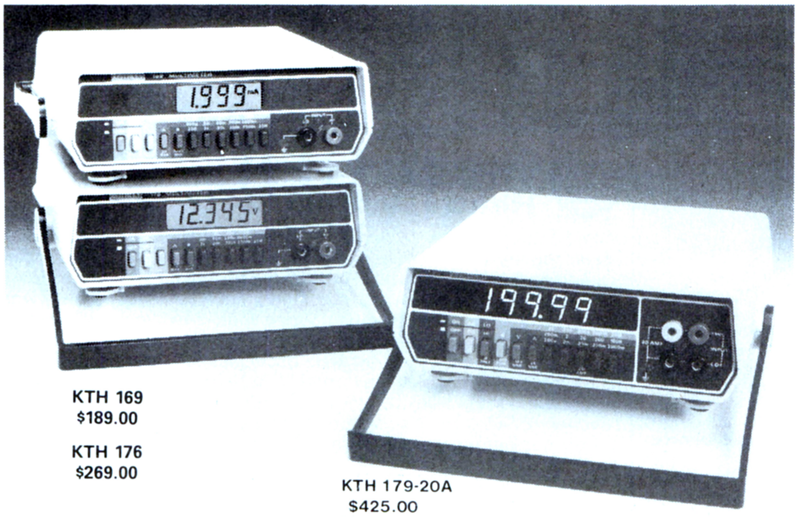
All Keithley products are fully warranted for one year. Prices shown are U.S. only; prices and specifications are subject to change without notice.

The professional thermometer/870. Keithley's experience with high performance scientific instruments as well as low-cost DMMs shows through with the Model 870 thermocouple (TC) based thermometer. The 870's type K (NiCr-NiAl) TCs offer low cost, good chemical inertness, physical durability and wide temperature span. ±(0.25%rdg + 1°C) accuracy, ±0.2°C repeatability and 0.1°C resolution is achieved through special electronic cold junction compensation circuitry which automatically compensates for ambient temperature changes. A special integrating A/D converter corrects for TC non-linearity. Both °C and °F scales offer two ranges with wide temperature span — from −40° to 1999°F and from −40° to 1370°C. Dual input capability permits two-point temperature measurements; analog output allows interfacing with chart recorders or data acquisition systems. Purchase price includes a 0.9m (3 ft.) beaded junction TC sensor. A full line of accessories and probes is available for use with the 870.

KTH 870 .... **$199.00**

VISIT OUR RETAIL SHOWROOM

PRIORITY ONE ELECTRONICS



KTH 169
$189.00

KTH 176
$269.00

KTH 179-20A
$425.00

KEITHLEY

Bench DMMs: solid price/ performance values.

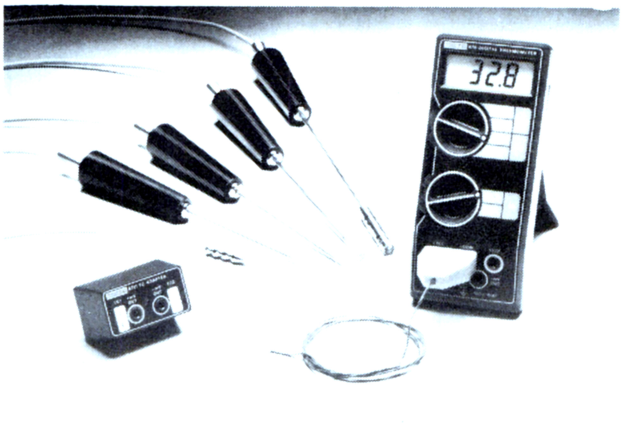
- Line or battery operation
- LCD or LED displays
- Bench-size convenience and security

Basic beauty/169. The sturdy, easy-to-use, simple-to-maintain Model 169 is a basic, no-frills, 0.25% DCV, 3½-digit line or battery operated DMM ideal for general purpose measurement applications and educational use. Excellent input protection on all five functions prevents electrical damage. Its low parts count and no-nonsense design give it a MTBF of 20,000 hours. Should it ever need repair, all components are easily accessible on one PC board. Range and function annunciators tell you at a glance what is being measured. Two input jacks and auto polarity mean no lead changing. Zeroing is automatic. Alkaline batteries give 2000 hours (1 year) of operation. The Model 1766 internal AC power supply option replaces the batteries for safe line operation. Only one adjustment is required at the annual calibration. **$189.00**

Bench bargain/176. The Model 176 has the same ease-of-use features as the 169 — annunciators, two input jacks, portability, color-coded front panel — but offers enhanced electrical performance. Its 4½-digit resolution gives 10 times the dynamic range of a 3½. DCV accuracy of 0.05% is 3 to 4 times better than that of the best 3½. Bandwidth is 20kHz on lower ranges. Alkaline batteries deliver 1000 hours of operation; safe line operation with the 1766 internal AC power supply is available. Feature for feature, the 176 is a smart way to move up to a 3½, or replace your old 4½ for less than it could cost to repair. **$269.00**

Top of the 4½'s/179-20A. From its large, bright LED display to its proven reliability and performance, the 179-20A is the outstanding 4½-digit DMM. 10μV AC/DC sensitivity and fuse-protected 20A capability offer vast measurement flexibility. TRMS ACV measurement capability allows accurate measurement of complex waveforms. HI-LO ohms makes two applied voltage levels available for measurement — LO for in-circuit checks without turning on semiconductor junctions, HI for quick checks with junctons turned on for diode testing. Input protection of 1kV on Ω and full protection on all other functions keep downtime to a minimum. A coded calibration shield keeps the annual calibration short. And all components are available off-the-shelf. The optional Model 1793 IEEE-488 Interface lets you interface with a low cost controller such as the Apple or PET to automate your test system. The 1793 can be field installed, or can be ordered already installed **$439.00**

	KTH 169	KTH 176	KTH 179-20A
OHMS			
Special Features	Diode test.	Diode test.	HI-LO
Sensitivity	100mΩ	100mΩ	100mΩ
Maximum Reading	20MΩ	20MΩ	20MΩ
Basic Accuracy ±(%rdg + digits)	0.2% + 1	0.2% + 2	0.04% + 1
Open Circuit Voltage	1.5V	5V	5V
Overload Protection	300V	300V	1000V
AC/DC AMPS			
Sensitivity	100nA	1μA	10nA
Maximum Reading	2A	2A	20A
Basic Accuracy AC ±(%rdg + digits) DC	1.5% + 5 0.75% + 1	1.5% + 5 0.5% + 2	1.0% + 15 0.2% + 2



	KTH 169	KTH 176	KTH 179-20A
Digits	3½	4½	4½
DC VOLTS			
Sensitivity	100μV	100μV	10μV
Maximum Reading	1000V	1000V	1200V
Basic Accuracy ±(%rdg + digits)	0.25% + 1	0.05% + 1	0.04% + 1
Input Impedance	10MΩ	10MΩ	10MΩ
Overload Protection	1000V	1000V	1200V
NMRR	> 50dB	> 60dB	> 60dB
CMRR	> 100dB	> 120dB	> 120dB
AC VOLTS			
Method	Average	Average	TRMS
Sensitivity	100μV	100μV	10μV
Maximum Reading	1000V	1000V	1000V
Basic Accuracy ±(%rdg + digits)	(45Hz-5kHz) 0.75% + 5	(45Hz-20kHz) 1.0% + 15	(45Hz-20kHz) 0.6% + 15
Input Impedance	10MΩ < 100pF	10MΩ < 100pF	1MΩ < 75pF
Overload Protection	1000V	1000V	1000V
GENERAL			
Power	Battery std., line opt.		Line std., battery opt.
Battery Life (alkaline)	2000 hr.	1000 hr.	6 hr. rechargeable
Environment	Operating: 0°C to 50°C. Storage: −35°C to +60°C		
Dimensions	3½" high × 9¼" wide × 10¾" deep (85mm × 235mm × 275mm)		
Weight	3.0 lb. (1.4kg)	3.6 lb. (1.7kg)	4.0 lb. (1.8kg)

All Keithley products are fully warranted for one year. Prices shown are U.S. only; prices and specifications are subject to change without notice.

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

ONE

The Industry Challenge: Make it smaller. Make it better. Make it cost less.
Non-Linear Systems has done it for three decades.

-1030.
TOUCH-TEST 20

MS-230. A whale of a miniscope.
With our ingenious, new MS-230, 30 -megahertz, battery-operated, dual-trace miniscope, portability's suddenly not a problem anymore. At 3 lbs. 10 oz., it's the smallest, lightest miniscope in the field today.

The state-of-the art MS-230 works wonders on site or in the shop. Anywhere there's a need to accurately test or measure electronics equipment.

The versatile MS-230 is perfect for TV repairmen. Services microcomputer systems when the chips are down. Maintains avionics equipment with flying colors. And diagnosis sophisticated medical equipment with the precision of a surgeon.

However, if your budget or needs demand something more economical or less sophisticated, chances are the MS-215 dual-trace or MS-15 single-trace will fit the bill.

FEATURES: ● Dual-Trace — 2-channel; separate, chopped or alternate modes. ● Warranty — one year parts and labor. ● 30-megahertz bandwidth. ● External and internal trigger. ● Time Base — 0.05 microseconds to 0.2 Sec./div — 21 settings. ● Battery or line operation. ● Line synchronization mode. ● Power comsumption less than 50W. ● Vertical Gain — 0.01 to 50 volts/div — 12 settings. ● Size: 2.9" H x 6.4" W x 8.5" D. ● Weighs only 3.5 lbs. wit batteries. ● TEST MOST DIGITAL LOGIC CIRCUITS INCLUDING MICROPROCESSORS.

VERTICLE: Mode: CH1, CH2, CH1 & CH2 (Chopped) & CH2 (Alt.) (The following specifications apply to each channel.) **Bandwidth:** DC to 30 MHz, ±3 db @ 3 division deflection. Typical 4 division deflection is obtainable up to 20 MHz. **Coupling:** AC, DC or ground, switch selectable. Low frequency 3 db point on AC is 3 Hz **Rise Time:** Approximately 10 nSec @ 3 division deflection. **Vertical Input:** 10 mV/div to 50 V/div in 12 calibrated ranges. Accuracy is 3%. **Input Impedance:** 1 megohm in parallel with 50 pF.

HORIZONTAL: Mode: Internal time base or external in XY mode, vertical input is thru CH1 and Horizontal thru CH2. **Time Base:** 0.1 † sec/div to 0.5 sec/div in 21 calibrated ranges; 3% accuracy. **Bandwidth:** DC to 1 MHz (±3 db). **Deflection factor:** 10 mV/div to 50 V/div in 12 calibrated ranges. **Max. Input Voltage:** 250 V (DC and peaqk AC). **Trigger Modes:** Automatic, internal, external, and line (line not functional when operating on battery power). **Slope Switch:** + or - **Coupling:** AC. **Sensitivity:** Less than 1 div for internal trigger. **CRT Viewing Area (Screen Size):** 1.1" H x 1.35" W. **Graticule:** 0.25 in./div (4 div H x 5 div W). **Power:** 3 rechargeable batteries or 115 VAC with transformer. **Battery Life:** Approx. 45 minutes. **Power Consumption:** Less than 50 watts. **Input Connector:** BNC; two shielded cables included. **Size:** 2.9" H x 6.4"W x 8.5" D. **Weight:** 3.5 lbs. with batteries.

		List	Our Price
NLSMS230	30 MHz Dual Trace Miniscope	$649.00	$579.00
NLSMS215*	15 MHz Dual Trace Miniscope	$497.00	$439.00
NLSM15*	15 MHz Single Trace Miniscope	$389.00	$345.00

*Typical 3 dB point is 8 MHz at 2-division deflection. Typical maximum frequency for full scale (4-div) deflection is 2 MHz.

NLS41141	Deluxe 10 to 1 100 MHz probe	$30.00
NLS41140	Leather case for MS15 & MS215	$45.00
NLS41180	Leather case for MS230	$45.00
BKP PR37RD	10 to 1, 1 to 1 100 MHz probe RED	$43.00
BKP PR37GY	10 to 1, 1 to 1 100 MHz probe GREY	$43.00
NLS411842	Charger unit 230 VAC (MS230)	$21.90
NLS411342	Charger unit 230 VAC (MS15 & MS215)	$7.70

The remarkable Touch Test 20 DMM.
With the Touch Test 20, Non-Linear Systems introduces the 2 lb. 4 oz. test lab. Now with 20 key test functions at your fingertips (plus the ability to measure 10 electrical parameters and 44 ranges), you can take one lab to the field instead of a cumbersome collection of individual testers.

Another bright idea. The Touch Test 20 is the only DMM with light pressure touch function selection. No more dials to fiddle with. Instead, an LED shows the function you choose. And when you switch, you get an audible bleep and visual blip to let you know.

This small wonder is miniaturization at its best. The new Touch Test 20 is the most innovative portable/bench-type multimeter in the industry today.

Voltage Measurements. Ac volts & AC millivolts — each function has three ranges; measurements from 10 microvolts to 750 VRMS. DC volts & DC millivolts — each function has three ranges; measurements from 10 microvolts to 1000 VDC. **Tenperature Measurements.** Degrees Celsius & Fahrenheit—two ranges; measurements from -40° to + 150°C or from -40° to +302°F.

Conductance Measurements.
Measurements from 0.01 nanosiemens to 1.999 nanosiemens which is equivalent to: from 5 megohms to 100,000 megohms.

Capacitance Measurements.
Microfarads, nanofarads & picofarads — six ranges combined measurements from 1.0 picofarad to 200 microfarads.

Current Measurements. AC amperes & AC milliamperes — four ranges; measurements from 10 microamperes to 10 amperes. DC amperes, DC milliamperes & DC microamperes — seven ranges combined; measurements from 0.01 microamperes to 10 amperes.

Resistance Measurements. Megohms, kilohms & ohms — seven ranges combined; measurements from 10 millohms to 20 megohms. **Other Tests.** Diode Test — A single quantitative means of checking diode and transistor junctions in both conducting and non-conducting directions. Continuity Test — Provides capability for audibly checking conductors and solder joints for shorts and open circuits, plus a go-no measurement of the amount of resistance from 10 milliohms to 2000 ohms.

ACCURACY SPECIFICATIONS: DC Voltage: DC volts & DC Millivolts ± (0.2% of Reading + 1 digit). **AC Voltage:** AC volts & AC millivolts, ± (0.5% of Reading + 2 digits) — 50 Hz to 10 kHz. **DC Current:** DC amps, DC milliamps & DC microamps ± (1% of Reading + *1 digit).* **AC Current:** AC amps + 2 digits) — 50 Hz to 10 kHz. **Temperature:** °C & °F, ±(3°C from -40°C to + 150°C). **Resistance:** ohms, kilohms & megohms, ± (0.25% of Reading + 1 digit). Test Current — 100 nA, 10 † A & 1 mA, Test Voltage — 0.2V max. @ F.S. up to 2 megohms. **Conductance:** nanosiemens, ± (0.2% of Reading + 2 digits). **Capacitance:** microfarad, nanofarad & picofarad, ±(1% of full scale). **Diode Test:** ±(0.2% of Reading + digit), Test Current — 1 mA ±2%.

TOUCH/TEST 20 comes complete with Test Leads, Temperature Probe, and component Test Adaptor. (LED Display).

PART #	LIST PRICE	OUR PRICE
NLS TT20	$435.00	$390.00
NLS TT20B	$467.00	$420.00

LCD Display (B Models with rechargeable batteries & charger).

NLS TT21	$495.00	$455.00
NLS TT21B	$525.00	$475.00
NLS 41140 Leather Carrying Case		$45.00

We stock the entire NLS line of panel meters, frequency counters, temperature probes, logic probes, & DVM. Call us with your requirements.

NLS CATALOG 180 page engineering selection guide	$2.00

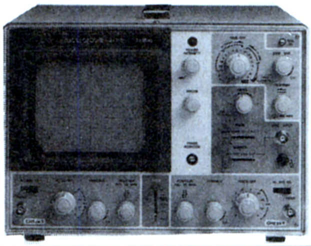
BUY WITH CONFIDENCE FROM THE NATION'S LARGEST

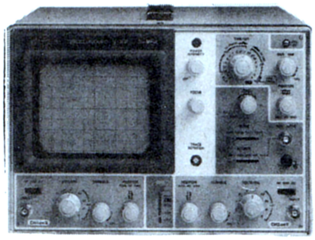
HITACHI DISTRIBUTOR
Hitachi Denshi, Ltd.

Single and dual trace, 15 and 30 MHz. All three high sensitivity Hitachi oscilloscopes are built to demanding Hitachi quality standards and are backed by a 2-year warranty. They're able to measure signals as low as 1mV/division (with X5 vertical magnifier). It's a specification you won't find on any other 15 or 30 MHz scopes. Plus: Z-axis modulation, trace rotation, front panel X-Y operation for all four scope models, and X10 sweep magnification. And, 30 MHz oscilloscopes offer internal signal delay lines. For ease of operation, functionally-related controls are grouped into three blocks on the color coded front panel. Now here's the clincher: For what you'd expect to pay more, you actually pay less. Check our scopes before you decide. All scopes come complete with probes.

List Price
$735.00
Our Price
$650.00
HITV152B

List Price
$995.00
Our Price
$859.00
HITV302B





● CRT Display area Acceleration potential Intensity modulation	130BUB31 (5-inch, round shape) 8x10div (1 div=9.5mm) Approx. 2kV Over 5Vp-p	130BTB31 (5-inch, round shape) 8x10div (1 div=9.5mm) Approx. 4kV Over 5Vp-p
● Vertical deflection Sensitivity and bandwidth Rise time Non-distorted Max. amplitude Signal delay line Input R and C Maximum input volt Display mode X-Y operation	5mV/div•5V/div ±5%, DC•15MHz, -3dB 1mV/div•1V/div±6%, DC•5MHz typ, -3dB (Using x5 amplifier) 24ns More than 4 div at 15MHz Direct 1M ohm, approx. 30pF 600V p-p or 300V (DC+AC peak) CH1, CH2, DUAL, ADD DIFF DC•500kHz, 5mV/div•5V/div Phase difference DC•10kHz3°	5mV/div•5V/div ±5%, DC•30MHz, -3dB 1mV/div•1V/div±6%, DC•5MHz -3dB (Using x5 amplifier) Typ, 12ns More than 4 div at 30MHz Permits viewing leading edge of displayed waveform Direct 1M ohm, approx. 30pF 600V p-p or 300V (DC+AC peak) CH1, CH2, DUAL, ADD DIFF DC•500kHz, 5mV/div•5V/div Phase difference DC•10kHz3°
● Horizontal deflection Sweep mode TV synchronization Internal External Trigger sensitivity	AUTO, NORM, TV (+), TV (-) TV sync-separator circuit Over 1div (V sync-signal) Over 1 Vp-p (V sync-signal) Frequency / Internal / External 20Hz•2MHz / 0.5div / 200mV 2•15MHz / 1.5div / 800mV	AUTO, NORM, TV (+), TV (-) TV sync-separator circuit Over 1div (V sync-signal) Over 1 Vp-p (V sync-signal) Frequency / Internal / External 20Hz•5MHz / 0.5div / 200mV 5•30MHz / 1.5div / 800mV
Trigger slope Sweep time Sweep-time magnifier Max. sweep rate	± 0.2 † /div•0.2s/div±5%, 19 calibrated steps 10 times (±7%) 100ns/div	± 0.2 † /div•0.2s/div #5%, 19 calibrated steps 10 times (±7%) 100ns/div
● Amplitude calibrator Waveform Voltage	1kHz ±10% Typ, Square wave 0.5V ±3%	1kHz ±10% Typ, Square wave 0.5V ±3%
● Power requirements	100V (120/220/240V) ±10% 50/60Hz, 40W	100V (120/220/240V) ±10% 50/60Hz, 40W
● Dimensions	Approx. 275(W)x190(H)x400(D)mm	Approx. 275(W)x190(H)x400(D)mm
● Weight	Approx. 8.5kg	Approx. 8.5kg
● Ambient Operating Temperature	0°+40°C	0•+40°C
● Probe	AT-10AB1.5 2	AT-10AB1.5 2

HIT V151B (Single trace version of **HIT-V152B)**

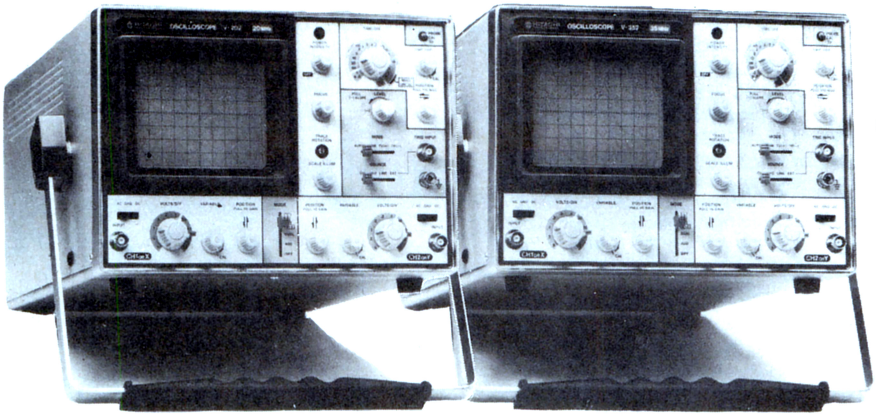
List Price	Our Price
$570.00	**$525.00**

CALL FOR QUANTITY PRICING

PRIORITY ONE ELECTRONICS

HITACHI
Hitachi Denshi, Ltd.

- *Square CRT with internal graticule (illuminated scale)*
- *High-accuracy voltage axis and time axis set at ±3% (certified at 10° to 34°C)*
- *High-sensitivity 1mV/div.*
- *Low drift*
- *2 Year Warranty*
- *Dynamic range 8 div.*
- *TV sync-separator circuit*
- *Built-in signal delay line (V-352)*
- *X-Y operation*
- *Sweep-time magnifier (10 times)*
- *Trace rotation system*
- *Fine-adjusting, click-positioning function*
- *2 probes included*



HIT-V352
35MHz DUAL TRACE WITH DELAY
List Price
$1150.00
OUR PRICE
$998.00

SH WT. 36 lbs

HIT-V202
20MHZ DUAL TRACE
List Price
$850.00
OUR PRICE
$765.00

SPECIFICATIONS:

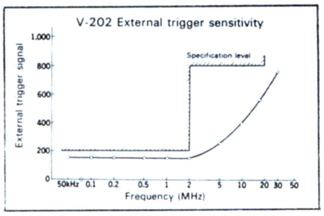
• CRT		
Display area	140BMB31R (5.5-inch square with internal graticule illuminated scale) 8x10 div (1 div=9.4mm)	140DFB31 (5.5-inch square with internal graticule illuminated scale) 8x10 div (1 div=9.4mm)
Acceleration potential	Approx. 2kV	Approx. 5.2kV
Intensity modulation	Voltage 5Vp-p or more Effective band-width DC to 2MHz Input impedance 47 ((type) Max. input voltage 300V (DC + AC peak)	Voltage 5Vp-p or more Effective band-width DC to 2MHz Input impedance 47 (type) Max. input voltage 300V (DC + AC peak)
• Vertical deflection		
Sensitivity	5mv/div to 5V/div ±3% 9-step changeover (When using x5 amplifier) 1mV/div to 1V/div ±5% Continuously variable when using x 2.5 amplifier with fine adjustment (provided with click-positioning function)	5mV/div to 5V/div±3% 9-step changeover (When using x5 amplifier) 1mV/div ±5% Continuously variable when using x 2.5 amplifier with fine adjustment (provided with click-positioning function)
Bandwidth	DC to 20MHz -3dB (at 8 div) (When using x5 amplifier) DC to 7MHz -3dB (at 8 div)	DC to 35MHz -3dB (at 8 div) (When using x5 amplifier) DC to 7MHz. -3dB (at 8 div)
Rise time	17.5ns (for x5) 50ns	10ns (for x5) 50 ns
Signal delay line		Permits viewing leading edge of displayed waveform
Max. input voltage	500Vp-p or 300V (DC + AC peak at 1kHz)	500Vp-p or 300V (DC + AC peak at 1kHz)
Input connection	AG GND DC	AG GND DC
Input impedance	Direct 1M ohm approx. 39pF	Direct 1M ohm approx. 30pF
Operating modes	CH1 CH2 DUAL ADD DIFF	CH1 CH2 DUAL ADD DIFF
X-Y operation	CH1 X axis CH2 Y axis	CH1 X axis. CH2 Y axis
Sensitivity	5mV/div to 5V/div (when using x5 amplifier 1mV/div)	5mV/div to 5V/div (when using x5 amplifier 1mV/div)
Phase difference	DC to 50kHZ within 3	DC to 50kHZ within 3
X bandwidth	DC to 500kHz -3dB	DC to 500kHz -3dB
Dynamic range	8div or more	8 div or more
• Horizontal deflection		
Sweep mode	AUTO NORM. TV (+) TV (-)	AUTO. NORM. TV (+). TV (-)
Sync signals	CH1 CH2 LINE EXT	CH1 CH2 LINE EXT
Sync connection	AC	AC
TV synchronization	TV sync-separator circuit	TV sync-separator circuit
Internal	1 div or more (V sync-signal)	1 div or more (V sync-signal)
External	1 Vp-p or more (V sync-signal)	1Vp-p or more (V sync-signal)
Trigger sensitivity	Frequency — Internal — External 20Hz to 2MHz — 0.5div — 200mV 2 to 20MHz — 1.5div — 800mV	Frequency — Internal — External 20Hz to 5MHz — 0.5div — 200mV 5 to 35MHz — 1.5div — 800mV
AUTO low bandwidth	20Hz	20Hz
Trigger polarity	±	±
External sync input	Input impedance approx. 1M ohm 30pF or less Max. input voltage 300V (DC + AC peak at 1kHz)	Input impedance approx. 1M ohm 30pF or less Max. input voltage 300V (DC + AC peak at 1kHz)
Sweep time	0.2 /div to 0.2/div ±3% 19 calibrated steps Continuously variable when using x2.5 amplifier with fine adjustment (provided with click-positioning function)	0.2 /div to 0.2s/div ±3% 19 calibrated steps Continuously variable when using x2.5 amplifier with fine adjustment (provided with click-positioning function)
Sweep time magnifier	10 times (±5%)	10 times (±5%)
Max. sweep rate	100ns/div (20ns/div or 50ns/div not calibrated)	20ns/div
Power: 100-240VAC 50 to 60Hz	Linearity within 3% or ±5% when using x 10	Linearity within 3% or ±5% when using x 10

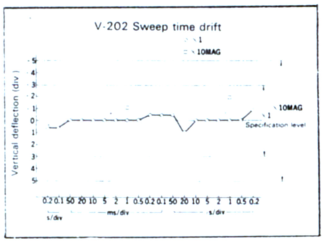
HITACHI OSCILLOSCOPES

Hitachi Oscilloscopes are innovative oscilloscopes designed and manufactured by Hitachi Denshi Ltd. The wide experience gained by Hitachi electronic specialists in producing oscilloscopes has resulted in this line of modern oscilloscopes featuring wider band width, more compact design, and light weight. Through adopting circuitry with linear IC's and logic IC's plus modern manufacturing techniques, including automatic component-insertion machines, these oscilloscopes offer increased stability, improved reliability, excellent performance and enhanced operating ease.

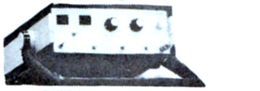
The panel layout is designed to create maximum operating ease by considering measuring processes and operation frequency. The layout is divided into three blocks according to respective functions identified by different colors. This convenience-oriented design for users improves daily controllability and drastically reduces operating errors.

Hitachi oscilloscopes are provided with 3% certified accuracy to assure reliable measurements.





WAVESAVER THE DIGITAL WAVEFORM RECORDER



At the touch of a button the WAVESAVER will record and display complex waveforms and transients with a resolution of 1024 bits horizontally and 8 bits (256) steps vertically (1K x 8 memory) for display on any oscilloscope. The WAVESAVER is not just for oscilloscopes either. Its output is chart-recorder compatible, effectively increasing the frequency response of chart recorders to 2μs (500 KHz) per point.

WAVESAVER $495.00

SPECIFICATIONS

Memory Size: 1024 x 8 **Vertical Resolution:** 256 steps (8 bits) **Maximum Digitizing Rate:** 2μs per point (500 KHz) **Recording Rates-Internal Clock:** 2μs to 100 ms per point, crystal controlled in 1, 2, and 5 steps. **External Clock:** 2μs to DC. **Maximum Input Sensitivity:** ±50mv full scale (for a full scale display output of 8 volts). **Minimum Input Sensitivity:** ±10 volts full scale (for a full scale output of 8 volts). **Input Impedance (all ranges):** 1 megohm, 15pF max. **Maximum Signal Input Level:** ±50 volts continuous, ±75 volts transient. **Internal Trigger Level Sensitivity:** TRACKS INPUT ±VOLTS selector. **External Inputs:** External Arm (TTL level); External Trigger (TTL level). External Clock (TTL level). **Recording Modes - Post Trigger:** Starts recording after detecting a trigger. **Pre Trigger:** Stops recording after detecting a trigger. **Outputs - Display Output:** 8 volts full scale **Trigger Output:** TTL level. **Scope/Plotter Selector:** SCOPE position 100 KHz; PLOTTER position 50 Hz (Selectable). **Digital Output Interface:** Eight-bit data output (Standard Binary); Sync signal (Data Valid); Clock In (for clocking recorded data out of the WAVESAVER's memory) **Physical Size:** L 9.5", W 10.1", H 3.6" **Shipping Weight:** 7 lbs. **Power Requirements:** 115 vac, 60 Hz @ 10 Watts maximum (105-115 vac, 55-65 Hz)

ORDER TOLL FREE (800) 423-5922

PRIORITY ONE ELECTRONICS

HITACHI
Hitachi Denshi, Ltd.

V550B 50MHz DUAL TRACE WITH 3 RD TRACE TRIGGER VIEW
V1050 100MHz DUAL TRACE WITH 3RD & 4TH TRACE TRIGGER VIEWS

Until now, if you wanted a 50MHz or 100MHz dual trace oscilloscope of uncompromising quality, there was only one choice. Now there is a second...outstanding new delay sweep scores with an established name—the Hitachi V550B and the V1050.

The HITACHI V550B (50MHz and V1050 (100MHz) offer all the capabilities you might demand from a lab grade oscilloscope. Capabilities such as 3rd trace trigger view, a bright 6" square CRT, and a max. sweep rate of 2ns/div (V1050) 5ns/div (V550B). Also features you may not expect like, sensitivity of 1 mv/div (V550B) .5mv/div (V1050) @ 10MHz, automatic focus correction, and a built-in TV sync separator circuit.

The cost? Remarkably reasonable especially when you compare it to the other leading 50MHz or 100MHz Dual trace oscilloscopes. It's a price breakthrough made possible by using up-to-date production techniques and a design backed up by over 20 years of oscilloscope experience.

A New C.R.T. Development

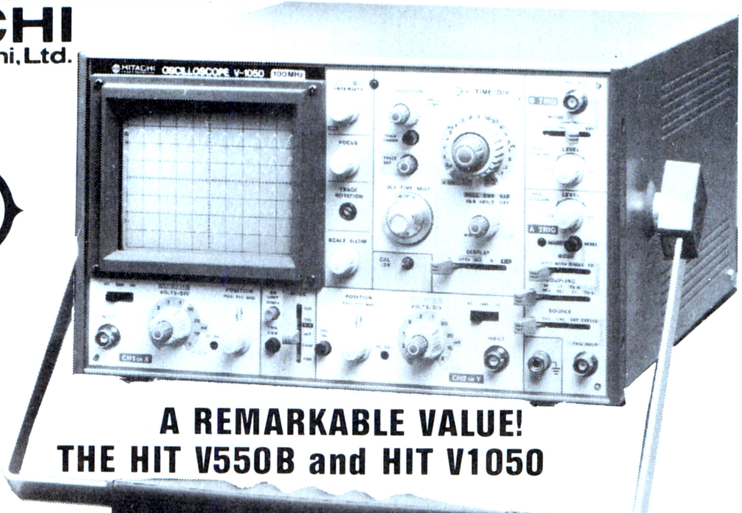
The large square C.R.T of V-550B & V-1050 is most advantageous not only for dual trace operations but also for third channel display of triggering signals. The width of the screen is 6" and the tube has an internal graticule. Care has been given to such details as graticule divisions in red which provide greater contrast in photography of data.

In the vertical axis, supplementary graticule markings of 0, 10, 90, and 100% are provided, which facilitates reading of rise time of pulse waves. Since these supplementary markings are in dots they do not interfere with ordinary measurements.

The use of an improved phosphor makes the new V-550B 10 kV tube as bright as old type 15 kV C.R.T.'s.

High Sensitivity: 1 mV/div. (10 MHz)

Sensitivity of 1 mV/div is useful for research and development in such applications as medical and biological experiements where signals are weak.



A REMARKABLE VALUE!
THE HIT V550B and HIT V1050

LIST
For $1745.00 and $2390.00 Respectively

CALL FOR OUR OEM PRICING THAT IS TOO LOW FOR US TO PUBLISH!

Automatic Focus Feature Eliminates Lag.

Loss of focus tends to occur when brightness or sweep range is altered. Automatic focus solves this problem, eliminating the necessity for adjustment each time.

Trace rotation system for easily adjusting bright-line inclination caused by terrestrial magnetism.

When bright lines are inclined by the influence of terrestrisal magnetism, this rotation system promptly compensates and corrects lines to the proper locations, rendering accurate observation constantly feasible.

Third Channel Display (Trigger View)

In addition to CH1 and CH2, CH3 can be observed. Internal triggered signals and external triggered signals can be displayed as a third trace. This feature allows time comparisons to be made between external trigger signals and displayed waveforms.

X-Y Operation Convenient for Observation of Two Types of Waves.

Delayed sweep permits 1,000 X Magnification

One of the qualifications for high performance oscilloscopes is that they be equipped with delayed sweep. Needless to say, the V-550B & V-1050 possesses delayed sweep which permits magnification of any desired portion of the wave up to a thousand times.

Variable Hold-off Circuitry Facilitates Pulse Measurement

The trigger hold-off circuitry is a variable hold-off circuitry specially developed for the V-550B & V-1050, permitting stable triggering on complex waveforms.

Single Sweep

The single sweep mechanism is indispensable for studying signals produced in research involving vibration, impact, explosion, and voice.

10 X Sweep Magnification Facilitates Precision Measurement

Delayed Sweep Jitter Held at Below 1/20,000

SPECIFICATIONS

C.R.T.

Type For V-550B
Hitachi 150BCB31 retangular mesh type tube with 10kV acceleration potential and metal backed phosphor.

Type for V-1050
Hitachi H9159P31 retangular mesh type tube with 20 KV acceleration potential and metal-backed phosphor.

Screen Type
P31 (GH) phosphor standard.

Useful Screen Area
8 x 10 div (1 div = 1 cm).

Graticule
Internal graticule with centimeter divisions and 2mm subdivisions along the central axis 10% and 90% lines are indicated. Illumination continuously variable.

Z-axis Input
DC-coupled positive-going signal decreases intensity: 5 Vp-p signal causes noticeable modulation at normal intensity: DC to 3.5 MHz.

VERTICAL DEFLECTION (2 identical Channels)

Bandwidth and Rise Time for V550B
DC to at least 50 MHz and rise time 7.0 ns or less DC to at least 10 MHz and rise time 36 ns or less as magnifier extends. Lower—3dB point, AC coupling 10 HZ or less. 10x probe: 1 Hz or less.

Bandwidth and Rise Times for V1050
DC to at least 100 MHz and rise time 3.5 nsec. or less. DC to at least 5 MHz and rise time 70 nsec. or less at 10x magnification. Lower—3 dB point. AC coupling 10 Hz or less. 10x probe: 1 Hz or less. Bandwidth may be limited to approx. 20 MHz by bandwidth limit switch.

Deflection Factor
5mV/div to 5V/div in 10 calibrated steps, 1-2-5 sequence. Uncalibrated continuous rate between steps 1: 2.5 x 5 magnifier extends min. deflection rate to 1mV/div. (V-550B).

Accuracy
±3% (+10 to 35°C)
±5% (0 to +50°C)
Additional error for magnifier ±2%

Display Modes
CH1, CH2 (normal or invert) Alternate, chopped (250kHz rate), Added.

Input Impedance
1M ohm ±2% in parallel with 30pF approx.

Maximum Input Voltage
250V (DC + peak AC) or 500V p-p AC at 1Khz or less.

Delay Line
Permits viewing leading edge of displayed waveform. 3rd Channel "A" Trigger view (V550B), 3rd & 4th Channel "A" & "B" Trigger view (V1050). Display simutaneously channel 1, channel 2, and external trigger signal(s). The deflection factor is approx. 200mV/div.

TRIGGERING A AND B

A Trigger Modes
Automatic. Normal, Single sweep, TV-V, TV-H.

A Trigger Hold-off
Adjustable control permits a stable presentation of repetitive complex waveform.

A Trigger Source
Internal (Ch1, Ch2), Line, External.

A Trigger Slope
+ or -

A Trigger Sensitivity V550B

	DC to 10MHz	DC to 50MHz
Internal	0.5div	1.5div
External	150mV	500mV

A Trigger Sensitivity V1050

Trigger	DC to 20 MHz	DC to 100 MHz
Internal	0.3 div.	0.5 div.
External	50 mV	150 mV

A Trigger Coupling
AC: 30HZ to full bandwidth
HF Rej: 30Hz to 4kHz
LF Rej: 4kHz to 50MHz (100Hz on V-1050)
DC: 0 to full bandwidth

A External Trigger Input Impedance
1M ohm ±20% in parallel with 30pF approx.

Maximum Input Voltage
250V (DC + peak AC)
500Vp-p AC at 1kHz or less

B Trigger Modes and Source
Automatic Normal (Internal, External)

B Trigger Slope
+ or -

Trigger Coupling
AC only: 30Hz to full bandwidth

HORIZONTAL DEFLECTION

Time Base A for V550B
50ns/div to 0.5s/div in 22 calibrated steps, 1-2-5 sequence.
Unicalibrated continuous control between steps 1: 2.5
10x mag extends fastest sweep rate to 5ns/div.

Time Base B for V550B
50ns/div to 50ms/div in 19 calibrated steps 1-2-5 sequence. 10x mag extends fastest sweep rate to 5ns/div.

Time Base A for V1050
20 nsec./div. to 0.5 sec./div. in 23 calibrated steps, 1-2-5 sequence
Uncalibrated continuous control between steps 1: 2.5

Time Base B for V-1050
230 nsec./div. to 50 msec/div. in 20 calibrated steps. 1-2-5 sequence. 10 X magnification extends fastest sweep rate to 2 nsec./div.

Accuracy On V550B
±3% (+10 to +35°)
±5% () to +50°C)
Additional error for magnifier ±2%

Accuracy On V1050
±2% or less (+10 to +35°C). Additional error for magnifier ±2%

Horizontal Display Modes
A only, A intensified, B delayed.

Calibrated Sweep Delay
Continuous calibrated control between 0.5 and 10x time base A setting.

X-Y OPERATION (Ch1: Horiz, Ch2; Vert)

Deflection Factor
Same as vertical deflection

Accuracy
Y: ±3% (+10 to +35°C), ±5% () to +50°C)
X:±3% (+35°C), ±7% () to +50°C)
Additional error for Ch1 and Ch2 magnifier ±2%

Bandwidth
DC to at least 500kHz (2MHz on V1050)

Phase Error
3° or less from DC to 50kHz

CALIBRATOR
0.5v ±1% Frequency 1kHz ±5% square wave

POWER
Line Voltage and Frequencies
108V AC to 132V AC, 49Hz to 61Hz
114V AC to 120V AC, 49Hz to 400Hz

POWER CONSUMPTION
45W or less at normal line voltage (50W or less for V1050)

DIMENSION AND WEIGHT
310(W) x 180(H) x 410(D) mm
(12.2 x 7.1 x 16.1 In.)
9.3kg (20.5 Lb.)

AMBIENT TEMPERATURES
Rated range of use: +10 to +35°C
Limits of operation: 0 to +50°C
Storage and transport: -20 to +70°C

M.T.B.F.
20,000 hours for target value

ACCESSORIES SUPPLIED
Two AT-10AD1.5 probes, 2-A fuse, protective cover, operation manual. Shipping Weight 29 lbs

VISIT OUR RETAIL SHOWROOM

PRIORITY ONE ELECTRONICS

B+K PRECISION DYNASCAN CORPORATION model 1500

the most adaptable easy-to-use 100MHz scope you can buy

100 MHz OSCILLOSCOPE • 1500

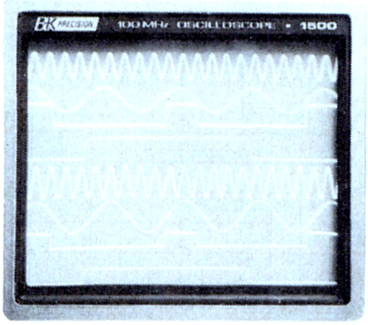
BKP1500P LIST $2575.00
OUR PRICE $2375.00

- 100 MHz response and 3.5nS rise time.
- 2nS division sweep rate with 10x magnifier.
- Eight-trace four-channel operation provides trigger views or four separate inputs.
- Dual time base operation.
- Switching power supply delivers best efficiency and regulation at lowest weight.
- Selectable 1MΩ or 50Ω inputs.
- Delayed sweep, 200nS to 0.5 seconds.
- Alternate time base operation.
- 20 MHz bandwidth limiter for best viewing of low frequency signals.
- Touch sensitive lighted pushbuttons with electronic switching and non-volatile RAM memory.
- Selectable chop frequencies.
- Voltage and current probe calibrators.
- 8 x 10 cm internal graticule CRT.
- Video sync separator standard.
- Dual intensity controls.

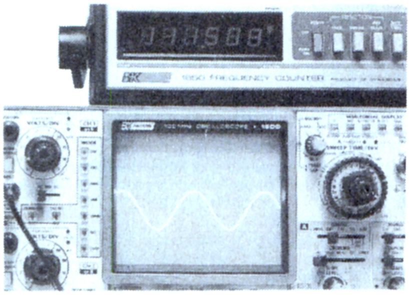
For engineering and service applications requiring the highest degree of measurement sophistication, B&K-PRECISION offers the new 100MHz model 1500. The 1500 brings ultra-high performance standards and a vast array of features into one efficient package. This new generation scope utilizes a combination of new techniques never before applied to oscilloscope design. As a result, the 1500 is efficient, light-weight and reliable.

APPLICATIONS:
Schottky, ECL and circuit development up to 100MHz...Performing accurate rise-time measurements...Observing propagation delays along digital circuits...Observing impedance matching along transmission line...Tracing and developing D/A and A/D converters...Telephone main frame circuit tracing and development, where high speed D/A and A/D conversion is involved...Observing transient glitches...Observing signals at rf and i-f frequencies.

For engineering and service applications requiring the highest degree of measurement sophistication, B&K-PRECISION offers the new 100MHz model 1500. The 1500 brings ultra-high performance standards and a vast array of features into one efficient package. This new generation scope utilizes a combination of new techniques never before applied to oscilloscope design. As a result, the 1500 is efficient, light-weight and reliable.



EIGHT-TRACE DISPLAY
The delay time base mode, in conjunction with the alternate horizontal display mode, operate on all four inputs, providing eight-trace capability. This system offers the engineer an added measure of capability for time savings and signal comparison.



FREQUENCY COUNTER OUTPUT
A buffered rear-panel output connects a sample of the channel 1 input input signal to your counter for simultaneous analog and digital frequency readouts. No adapters are required.

SPECIFICATIONS

VERTICAL AMPLIFIERS (CH1 and CH2)

Deflection Factor: 5mV div. to 5V div. ±3% in 10 ranges: 1-2-5 sequence, each providing fine adjustment LED warning light indicates uncalibrated setting. X5: 1mV/div. to 1V/div.
Frequency Response: DC: DC to 100MHz (-3dB); **AC:** 5Hz to 100MHz (-3dB); **X5: DC:** DC to 100MHz (-3db); **AC:** 5Hz to 100MHz (-3dB). Frequency response can be limited to approximately 20MHz by bandwidth limit switch.
Rise Time: 3.5ns or less. **X5:** 3.5ns or less at both 50Ω or 1MΩ.
Non-Distorted Maximum Amplitude: More than 8 divisions, DC to 100 MHz.
Maximum Input Voltage: 1MΩ: 250V (DC + AC peak) or 500 Vp-p: 50Ω: 5VRMS, ±5VDC.
Input Impedance: 1MΩ±2% paralleled by 28 pF ± 3pF, 50Ω nominal (switch selectable).
Input Coupling: AC, GND, DC, 50Ω.
CH1 Output: (BNC terminal on rear panel) for simultaneous use of frequency counter, DVM, additional scope, etc. Output voltage: 50mV p-p/div.; Frequency Response: 2Hz to 100MHz; Output impedance: 50Ω.

VERTICAL AMPLIFIERS (CH3 and CH4)

Deflection Factor: 100mV/div. and 1V/div. ±3%.
Frequency Response: DC: DC to 100MHz (-3dB); **AC:** 5Hz to 100 MHz (-3dB).
Rise Time: 3.5ns or less.
Maximum Input Voltage: 50V (DC + AC peak).
Input Impedance: 1MΩ±2% 28pF ±3pF.

VERTICAL AMPLIFIERS (CH1, CH2, CH3, CH4)

Operating Modes: CH1, CH2, Dual (ALT/CHOP), QUAD (ALT/CHOP), ADD.
Chop Frequency: 2 ranges: 250 KHz nominal, also 260 KHz.
Signal Delay Line: Fixed approx. 30ns visible delay.
CH2 Polarity: Normal or Inverted.

SWEEP SYSTEM

Time Base A: 20ns/div. to 5S/div. 1-2-5 sequence, 23 steps.
Time Base B: 20ns/div. to 50ms/div., 1-2-5 sequence, 20 steps.
Accuracy: ±3%.
Sweep Vernier: Continuously variable between steps, LED warning light indicates uncalibrated setting.
Sweep Magnification: 10X, ±5%.
Linearity: ±3%, 10X, ±5%.
Horizontal Display: Modes A, A INTENSIFIED by B, ALT, B-delayed, Dual, X-Y.

Calibrated Sweep Delay Time: 0.5 seconds to 200ns.

TRIGGERING

Mode: AUTO (free run): NORM, SINGLE/RESET, FIX.
Source A Sweep: V MODE, CH1;, CH2; EXT: CH3; CH3/10.
Source B Sweep: CH1, CH2; EXT: CH4, CH4/10.
Coupling A Sweep: AC: 20Hz to 100MHz; LF-rej: 30KHz to 100MHz; HF-rej: 20Hz to 30KHz, DC: DC to 100MHz.
Coupling B Sweep: AC: 20Hz to 100MHz; LF-rej: 30KHz to 100MHz; HF-rej: 20Hz to 30KHz; DC: DC to 100MHz.

TRIGGER SENSITIVITY **Coupling**	**Bandwidth**	**Min. Sync. Volts** **Int. (DC)**	**Ext.**
Normal:	Up to 20MHz	0.3 Div.	30mV
	Up to 50MHz	1.0 Div.	100mV
	Up to 100MHz	1.5 Div.	150mV
Fix:	40Hz to 20MHz	0.5 Div.	50mV
	40Hz to 80MHz	1.5 Div	150mV
Video	Frame/Line	0.5 Div.	50mV
Auto:	Free runs at sweep freqs. less than 30Hz. As above for sweep rates greater than 30Hz.		
AC:	Requirements increase below 20Hz.		
LF Rej:	Requirements increase below 30KHz.		
HF Rej:	Requirements increase below 20Hz and above 30KHz.		

Trigger Level Range: (ext. trig.) a/a: ±5V(1Vp-p); 1/10 ±5V(10Vp-p).
Slope (A,B): Positive and negative.
Level (A, B): Permits selection of triggering at any point on the positive and negative slope of the displayed waveform.
Hold Off: Continuously variable from zero (NORM) to more than 10 times.
Jitter: 0.5nS or less at 2nS/div. 100MHz input.
FIX: Triggering at center level of the displayed waveform.

HORIZONTAL AMPLIFIER (Input through channel 2 input.)
Deflection Factor: Same as vertical CH. 2.
Frequency Response: DC: DC to 5MHz (-3dB).
AC: 5Hz to 5MHz (-3dB).
Input Impedance: Same as vertical CH. 2.
Maximum Input: Same as vertical channel 2.
X-Y Operation: CH 2 becomes X axis; CH 1 is Y axis.
X-Y Phase Difference: 3° or less at 100KHz.

Z-AXIS INPUT (Intensity Modulation)
Sensitivity: 5V (TTL compatible). Positive voltage increases intensity.
Useable Frequency Range: DC to 10MHz.
Input Impedance: 10kΩ.
Maximum Input: 50V (DC + AC peak).

OPERATION SPECIFICATIONS

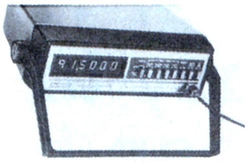
Operating Environment: 0° to 50°C (10° to 35°C full specifications).
Altitude: (operating) Up to 5000 meters (at 18-20°C).
Humidity: 85%.
CRT: (6") diagonal, with 8x10 division internal illuminated graticule (1 div. = 1cm); P31 phosphor.
Accelerating Voltage: 16kV.
Calibration Output: (voltage) internal 0.3Vp-p, ±1% (square wave at 1KHz ± 3%). (Current probe) 10mA p-p, 2% at 1KHz.
Gate Outputs: Positive gate output from each time base, available on rear panel. 1.5V p-p into 500Ω.
Power Requirements: 90-132 VAC; 180-264 VAC. 50-60Hz, approx. 56 watts.
Size: 13.8 x 18.4 x 40 cm (5.4 x 11.2 x 15.75"). (HWD)
Weight: 7.5 kg (16.5 lbs.)
Probes: Two 10X probes supplied.

OPTIONAL ACCESSORIES

BKPLC-100 Front Panel Cover. Snaps on: offers protection for field service or storage. **$ 26.00**
BKPLC-150 Vinyl carrying case for probes and cables. **$ 32.00**

ORDER TOLL FREE (800) 423-5922

80 MHz COUNTER WITH PERIOD MODE AND TIMER



BKP1820
LIST PRICE
$315.00
OUR PRICE
$285.00

FEATURES: 5Hz to 80MHz reading guaranteed—100MHz typical • Period measurements from 5Hz to 1MHz. • Period average, auto and manual positions • One PPM resolution • Totalizes to 999999 plus overflow • Elapsed time measurements from .01 to 9999.99 seconds plus overflow • One-megohm input resistance • Bright., 43" high LED readouts.

SPECIFICATIONS: FREQUENCY—Range: 5HZ to 80MHz Gate Time Auto: 10ms (MHz) and 100ms and 1 sec. (kHz). Gate Time Man.: 1 sec. (1Hz reso.) **Accuracy:** ±t.b. accur. ±1 count. **Resolution:** *±0.0001% (i.e. 1PPM of a 6 digit scale).* **PERIOD—Range:** 5Hz to 1MHz; s (100 period aver.) or AUTO reading. **Period Aver. Auto:** 1 period aver. (ms), 10 and 100 period aver. (μ). **Period Aver. Man.:** 100 and 100 period aver. (μs reading with 1ns reso.). **TOTALIZE CHAR. — Range:** 5Hz to 80MHz; 0 to 999999 plus overflow. **Control:** Man. reset to 0; convertible to remote reset. **ELAPSED TIME—Range:** .01 to 9999.99 sec. plus overrange. **Trigger:** TTL or contact closure. **Reset:** Manual on front panel. **INPUT—Impedance:** 1 MΩ; 25pF. **Coupling:** AC. **Sensitivity:** 30mV rms, 5Hz to 40MHz; 50mV max. at 80MHz. Derate linearly to 100 V (peak AC + DC) at 1kHz, **Max. Input:** 200V (peak AC + DC) DC to 500 Hz, derate linearly to 30V (peak AC + DC) @ 80MHz. **Attenuator:** X10 switch sel. **INT. TIME BASE**—(25°C, ½ hour warm-up) 10MHz Crystal Oscillator. **Setability:** ±0.1 PPM (± 1Hz). **Stability:** ≤±1PPM for ±10° Line Voltage Variation; ≤±0.001% (i.e. ± 10 PPM) from 0° to 50°C ambient. **Max. Aging:** ±1 PPM/YR. **Ext. Input:** TTL Level, switch sel., **General—Power:** 105V to 130V and 212 to 258V, 50/60 Hz. **Size (HWD):** 8.1 x 29 x 19 cm. (3.25 x 11.6 x 7.50") incl. handle. **Weight:** 1.4 kg (3 lbs).

PORTABLE AUTORANGING DIGITAL CAPACITANCE METER

BKP830
SH WT 4 lbs.

LIST PRICE $229.00 OUR PRICE $209.00

- Automatically measures capacitance from 0.1pF to 200 mF
- 0.1pF resolution
- No range switching
- 10 internal ranges for accuracy and resolution
- 0.2% basic accuracy
- Range hold switch
- Zero control for test lead compensation
- 3½ digit LCD display
- Banana jacks and special lead insertion jacks
- Battery or AC operation
- Fuse-protected

CAPACITANCE:

Range: 10 automatically selected ranges with full scale value from 199.9pF to 199.9mF (reads from 0.1pF to 0.2F, with resolution of 0.1pF). **Accuracy:** Auto 2% of reading, ±1 digit from 20uF to 199.9mF; Hold all specs between 180 and 1999 counts same as Auto; for all readings between 0 and 179 counts add: 0.1% of full scale to 19.99mF full scale. **Resolution:** 0.1pF on lowest range and 0.05% of full scale on all other ranges. **Reading Time:** 0.4-1.0 SEC to 0.20mF; increasing to 6 SEC at 200mF. **Zero Control:** Can compensate up to 25pF of test lead capacitance. Minus sign (-) indicates overcompensation. **Overrange Indicator:** (All Ranges) plus sign (+) with blank display and mF LED on.

GENERAL:

Display: 3½ digit LCD display. **Front Panel Controls:** Range HOLD switch, ZERO adjust, ON-OFF switch. **Power Source:** 4 standard "C" size cells operating from 4.2-6 volts, nicad, alkaline, or zinc carbon, with provision for AC adapter/charger. (Note: batteries and charger are not supplied.) **Battery Life:** 20 hours minimum continuous use.

BKP820

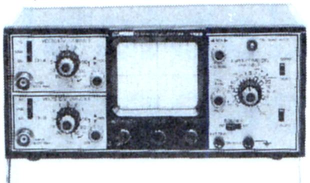
LIST PRICE $185.00 OUR PRICE $170.00

FEATURES: Measures capacitance to 1 Farad in 10 ranges • Resolves to 0.1pF on lowest range • 4 digit easy-to-read LED display • 0.5% accuracy • Special lead insertion jacks and banana jacks • Fuse protected • Uses either rechargeable or disposible batteries • Overrange indication.

SPECIFICATIONS: Capacitance—Range: 0.1pF to 1000 millifarads (1 Farad) in 10 ranges. **Accuracy:** 0.5% of F.S. ± 1 digit to 100uF; 1% of F.S., ± 1 digit from 1000uF to 1000mF. **Resolution:** 0.1pF on lowest range. **Reading Time:** 0.6 sec to 10 mF, increasing to 35 sec max. at 1000mF. **Overrange:** Bottom segments of digits are "ON" for overrange. **GENERAL: Display:** 4 digit LED. **Power:** (4-6 volts) 4 standard "C" size cells, nicad, alkaline or zinc carbon, with provision for charger (batteries and charger not supplied). **Battery Life:** 8 hours.

B+K PRECISION DYNASCAN CORPORATION

DUAL TRACE 15 MHz AC/DC/BATTERY MINI-SCOPE



LIST PRICE $825.00 OUR PRICE $750.00

BKP1420

- 15MHz response; usable beyond 20MHz
- 10mV/div vertical sensitivity
- Conveniently fits into ordinary attache case—only 11 x 22 x 30cm (4.5 x 8.5 x 12") with handle.
- Operates on AC, external 10-16 VDC or optional internal battery pack
- 8 x 10 division high-brightness rectangular CRT
- 18 calibrated sweep positions
- Video sync separator standard
- TIME/DIV control selects line/frame rate triggering for video applications
- 10:1 direct probes included
- Front-panel probe calibration source
- Weighs only 3.6 kg. (8 lbs.)

SPECIFICATIONS:

VERTICAL AMPLIFIER

Deflection Factor: 10mV/div. to 20V/div. ±5% in 11 ranges, each with vernier adjustment. **Frequency Response: DC:** DC - 15MHz (-3dB). **Rise Time:** 24nsec or less. **Overshoot:** 3% or less. **Input Impedance:** 1MΩ shunted by 26 pF. **Maximum Input:** 300V (DC + AC) peak or 600V p-p. **Operating Modes:** Channel A only; Channel B only; A&B (dual). **Dual-Trace:** Trace automatically chopped at all sweep rates less than or equal to 1msec/div. and alternate mode for all sweep rates greater than 1msec/div. **Chop Frequency:** 100kHz + 20%. **Channel Separation:** Better than 60dB at 1kHz.

SWEEP SYSTEM

(Common to Channel A and Channel B)

Type: Automatic and triggered (NORM): auto provides sweep with no input signal. **Sweep Time:** 1.0 μs/div. to 0.5 S/div. ±5% in 18 ranges in a 1-2-5 sequence, variable between ranges. **Linearity:** 3%. 10X ±5%. **Sweep Magnification:** x10, ±10%. Extends maximum sweep rate to 100 ns/div.

HORIZONTAL AMPLIFIER

Input through Channel B vertical input. **Deflection Factor:** 10mV/div. to 20V/div. ±5% in 11 ranges, each with fine adjustment. **Response: DC:** DC to 1MHz (-3dB); **AC:** 10Hz to 1MHz.

TRIGGERING SOURCE:

CHA, CHB, (CHA in dual) ext automatic, normal, video sync. Slope: ± of trigger waveform.

OTHER SPECIFICATIONS

Operating Environment—Temp: 0 to + 45 C. **Calibration:** Internal 1Vp-p ±3% (square wave at 1kHz nominal). **CRT:** Rectangular. 8 x 10 div. (0.5cm/div) with P31 phosphor; mumetal shield. **Power Requirements:** 120VAC-60Hz, 240VAC-50Hz, 10-16VDC or internal battery. Power consumption: 16 watts (AC). Supplied with 120VAC adapter. 250VAC adapter available on special order. **Size: (HWD)** 11 x 22 x 30cm (4.5 x 8.5 x 12") with handle. 8 x 20 x 25cm (3.25 x 7.75 x 10") without handle. **Weight:** 3.6kg (7.75 lbs.) with optional battery. **Probes:** Two 10:1/direct probes and accessory tips provided.

OPTIONS:

BKPPP14	Battery Pack	**$58.00**
BKPLC20	Deluxe carrying case	**$41.00**
BKPLC21	Pouch for probes	**$16.50**

3" 5 MHz SOLID STATE OSCILLOSCOPE

$299.00
B&K-PRECISION
Model

BKP1405

FEATURES: 5MHz with high sensitivity • Direct deflection input for waveforms to 450MHz • Sharp bright trace • DC amplifiers on both axes • 10mV/div vertical sensitivity • Weighs only 8.5 lbs. The 1403A is an outstanding value. Bandwidth extends to 5MHz with a sensitivity of 10mV/div or better. With high brightness CRT and smoked-glass filter, waveforms are clear and easy to observe. The graticule features db and division indexing.

SPECIFICATIONS: Vertical Amplifier—Sensitivity: 10mV/div or better. Response: DC, DC-5MHz (-3dB); AC, 2Hz-5MHz (-3dB). Max Input: 600V peak to peak. **Input Impedance:** 1 meg shunted by 35pF. Attenuator: 1, 1/10, 1/100 multiplier, ±5%. Gain Control Range: greater than 22dB. **Horizontal Amplifier**—Sensitivity: 300mV/division or better. Response: DC-250kHz. max Input: 100 Vp-p. **Sweep System**—Type: Recurrent. Time Base Ranges: 10-100Hz, 100-1000Hz, 1-10kHz, 10-100kHz, continuously variable between ranges. Sweep Linearity: ±5%. Sync: Internal, negative; external. **Direct Deflection Terminals:** 10V/division sensitivity or better. **General**—Intensity Modulation: 25Vp-p **Power:** 117234VAC, 50-60Hz, 10W; three-wire grounded line cord. **Acc.incl.:** Leads spare fuse, instructions. **Size: (HWD)** 13.1 x 18 x 29 cm (5.25 X 7.25 x 11.5"). **Weight:** 3.8 kg. (8.5 lbs.). Optional Accessories: PR-21 probe. LC-14 case.

DUAL-TRACE 30 MHz DELAYED SWEEP SCOPE

LIST PRICE
$1365.00
OUR PRICE
$1225.00

BKP1530

- Delayed sweep operation for sweep expansion up to 1000x
- 30MHz response; usable to 50MHz
- 5mV/division sensitivity selectable 2mV to 20MHz
- Variable hold-off for pulse train display
- Single-sweep for nonrepetitive waveforms
- Built-in triggering filters
- Video sync separator standard
- CHOP or ALTERNATE display
- Rectangular high-brightness internal graticule mesh-type PDA CRT
- Differential input capability
- 11.7ns rise time for short duration pulses
- Alternate trigger capability
- Front panel x-y operation
- 10:1/reference/direct probes Included

SPECIFICATIONS:

VERTICAL AMPLIFIERS (CH A AND CH B). **Deflection Factor:** 2mV/div; 5mV/div to 5V/div, ±3% in 10 steps. 1-2-5 sequence with vernier. **Frequency Response:** (5mV/div to 5V/div) DC: DC to 30MHz (-3dB). AC: 5Hz to 30MHz (-3dB). (2mV/div) DC: DC to 20MHz (-3dB). AC: 5Hz to 20MHz (-3dB). **Rise Time:** 11.7ns or less. 17.5ns or less at 2mV/div. **Overshoot:** 3% or less (100kHz sq. wave). **Input Impedance:** 1MΩ, ±2%, 23pF, ±3pF. **Non-Distorted Max. Amlitude:** ≤8 div. DC to 30MHz. **Max. Input V.:** 300v (DC + AC peak) or 600Vp-p. **Operating Modes:** CH A, CH B, DUAL, ADD and subtract (using CH B invert). **Alternate/Chop Selection:** Switch selectable. Always alternate with ALT trigger source selection and at sweep times of .5ms/div to 2μs/div. **Chop Frequency:** Approximately 200kHz. **Channel B Polarity:** Normal or inverted. **Channel Separation:** 60dB minimum.

HORIZONTAL AMPLIFIER (input thru CH B) **X-Y Operation:** With SWEEP TIME/DIV switch in CH B position, CH A input becomes Y axis (vertical) and CH B input becomes X axis (horizontal). **Deflection Factor:** Same as vertical amp. **Input Impedance:** Same as vertical amp. **Frequency Response:** DC: DC to 2MHz (-3dB). AC: 5Hz to 2MHz (-3dB). **X-Y Phase Difference:** 3 or less at 100kHz.

TIME BASE

OPERATING MODES: Normal: triggered sweep. **Automatic:** sweeps in absence of trigger, triggered sweep in presence of trigger. **Single:** when triggered, one sweep is generated Manually reset. **Sweep Time** 0.2μs/div to 0.5s/div ±3% in 20 ranges, in 1-2-5 sequence with vernier. **Sweep Magnification:** X5 ± 10%. Extends max. sweep rate to 40ns/div. **Linearity:** ±3% (±10% on 0.5μs/div and 0.2μs/div range at 5X mag).

DELAYED TIME BASE

Delay Time: 1μs in 5 ranges: vernier. **Intensity Modulation:** INTEN switch allows portion of sweep after delay to be intensified. **Independent Delay:** with ALT triggering source, channel A or channel B sweep can be independently delayed. **Delay Jitter:** < 1 part in 10,000.

TRIGGERING

Source: Alternate, channel A, channel B, line (50/60Hz power line), and external. **Mode:** Normal, automatic, and single. **Slope:** Positive or negative. **Level:** Continuously variable or fixed. In FIX mode, level is automatically fixed at center of sync waveform. **Hold Off:** Continuously variable from NORM to more than 10 times (MAX). **Coupling:** AC. LF reject. HF reject. DC. **Video:** FRAME-LINE switch permits triggering from horizontal (LINE) or vertical (FRAME) sync pulses of composite video signal. **LF Rej:** Attenuate signals below 10kHz. **HF Rej:** Attenuate signals above 100kHz. **Z-AXIS INPUT** (Intensity Modulation) **Sensitivity**—2V p-p (TTL compatible). Positive voltage increases brightness. **Bandwidth:** DC to 5MHz. **Input Impedance:** 10kΩ. **Maximum Input Voltage:** 50V (DC + AC peak).

OTHER SPECIFICATIONS:

Operating Environment: 0 to + 45 C. **Calibration Voltage:** 0.5V p-p (±1%) square wave: positive polarity. ikHz (±3%). **Trace Rotation:** Electrical. adj. from front panel. **CRT:** 140mm retangular CRT (qpprox. 5"). internal 8 x 10 division graticule. 1 division = 9.5mm. **Acceleration Voltage:** 6kV. **Power Requirements:** 117/23450/60Hz. 28 watts. (Constant calibration 105-130VAC.) **Size without handle (HWD):** 19 x 26 x 37.5cm (7⅜ x 10⅛ x 14¾"). **Weight:** 8.6kg (19 lbs.)

DESIGN OF ACTIVE FILTERS, WITH EXPERIMENTS

by Howard M. Berlin. An introduction to the implementation and design of active filter circuits that use the popular 741 op-amp chip. 240 pages; 5½ x 8½; softbound.

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IC TIMER COOKBOOK

by Walter G. Jung. Provides an excellent introduction to the field of IC timers by presenting a collection of various circuit "recipes" useful in applying the devices. 288 pages; 5½ x 8½; softbound.

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A complete line of function and pulse generators from B+K PRECISION DYNASCAN CORPORATION

BKP 3030 List $645.00 **Our Price $585.00**

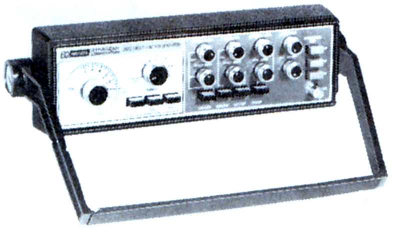
- Generates sine, square, triangle, positive square, negative square, positive ramp and negative ramp waveforms.
- Covers .001Hz to 5MHz.
- 4 decade, 10,000:1 log sweep range: 3 decade 1,000:1 linear sweep range.
- High-accuracy Kelvin-Varley frequency sweep start/stop controls.
- Wide range variable symmetry control for virtually any wave shape.
- Calibrated output attenuation from 10 dB to 60 dB.

Waveforms: Sine, square, triangle, sweep ramp, sweep pulse, TTL pulse, dc. **Modes:** Continuous, linear sweep, logarithmic sweep, tone burst, single cycle. **Frequency Range:** 0.001Hz to 5MHz in 8 ranges, 1000:1 frequency control. **Accuracy:** ±(1.5% setting +1% full scale) from 0.001Hz to 1MHz, ±(2% setting +2% full scale) from 1 MHz to 5MHz. **Amplitude Stability:** 0.25% of setting after 15 minutes. **Frequency Stability:** 0.25% of setting after 15 minutes. **Main Generator Output:** Sine, square, triangle selectable. **Output Amplitude:** 20 Vp-p into open circuit maximum, 10 Vp-p into 50Ω, 50Ω output impedance. **Attenuation:** Amplitude control provides 20 dB variable attenuation. Calibrated attenuator provides 60 dB attenuation in 10 dB steps. Total 80 dB. **DC Offset and DC Output:** Available at 50Ω output. Continuously variable ±10 VDC into open circuit, ±7.5 VDC into 50Ω. **Variable Symmetry:** Adjusts main generator output. Continuously variable from 5.95 to 95.5. Frequency divided by approximately 10. **Internal Sweep:** Linear or logarithmic sweep limit set by precision Kelvin-Varley dividers. **Internal Sweep Rate:** 10 ms to 10 s in four calibrated steps with variable X10 multiplier for up to 100 s. **Internal Sweep Width:** 1000:1 linear, 3 decades; 10,000:1 log, 4 decades. **Internal Sweep Output (f:V):** Approximately 0 to +5V output for 1000:1 linear (10,000:1 log) frequency sweep range. **External Sweep Input (V:f):** Approximately 0 to +5V input for 1000:1 linear (10,000:1 log) frequency sweep. **Triggered Modes:** 1.6V trigger input threshold or manual pushbutton. Single cycle—one complete cycle output per pulse trigger input. Tone burst—sustained output while trigger input applied (last cycle completed when trigger removed). **Square Wave Symmetry:** Better than 99% from 1Hz to 5MHz. **Square Wave Rise/Fall Time:** <50 ns. **Square Wave Overshoot:** <5% of peak voltage. **Sine Wave Distortion:** <0.5% from 1Hz to 100KHz. All harmonics <30dB down from 100KHz to 5MHz. **Amplitude Flatness:** <0.1dB too 100KHz. <±1 dB to 5MHz. **Triangle Wave Linearity:** >99% from 0.1Hz to 100KHz. **Sweep Pulse Output:** TTL compatible square wave (approximately 5V peak). **Operating Environment:** Specifications valid from 25° ±5° C to 50° C after 30 minutes. **Power Requirements:** 100/120/220/240 VAC, 50/60Hz, 30 W. **Size (HWD):** 5" x 12/5" x 11" (12.7 cm x 31.8 cm x 27.9 cm). **Weight:** 10 lbs (4.5 kg.)

BKP 3300 List $375.00 **Our Price $345.00**

- Pulse period range of 200 nanoseconds to 1 second; frequency range of 5MHz to 1Hz.
- Identical pulse width and delay ranges of 100 nanoseconds to 1 second.
- Can be used with an oscilloscope for adjustable sweep delay.
- Rise time is less than 15 nanoseconds for 50 Ohm high-speed output.
- TTL output.
- LED overlap indicator reveals incorrect control settings.
- Adjustable input-trigger level for use with arbitrary waveforms and for pulse reconstruction.
- Pulse-burst capability allows convenient testing of counters and shift registers.

Waveforms: Pulse, square wave. **Modes:** Triggered delay, fixed delay, DC, pulse delay, invert, square wave, manual 1Hz to 5MHz (1s to 200 ns period). **Frequency Range:** in decade steps continuously adjustable. **Accuracy:** Overlapping ranges. **Main Generator Output or Pulse Output:** Fixed TTL level. **Output Amplitude:** 50Ω: 0.25V to 10V open circuit: 0.15V to 5V into 50Ω. 600Ω: ±0.15 to±0.15 to +7.5 into 600Ω Can be offset to 0V. **Attenuation:** Amplitude controls provide continuously variable attenuation up to a maximum output amplitude. **DC Offset and DC Output:** Available at 600Ω output variable from ±15 VDC open circuit. ±7.5 VDC into 600Ω. **Pulse Width:** 100 ns to 1 s in 7 decade ranges, 1 decade linear vernier. **Pulse Delay:** 100 ns to 1 s in 7 decade ranges, 1 decade linear vernier. **External Trigger:** Selectable over ±18V range or fixed TTL level. **Triggered Modes:** All modes can be triggered externally except continuous and manual (push-button trigger). **Square Wave Time Symmetry:** 50% of duty cycle. **Square Wave of Pulse Rise/Fall Time:** 600Ω output: 75 ns; 50Ω outputs: 15 ns; TTL output: 20 ns. **Indicators:** Overlap LED, power LED. **Operating Environment:** 0-50° C. **Power Requirements:** 105-130 VAC, 60Hz, 28W. **Size (HWD):** 3.2" x 11.3" x 7.8" (8.1cm x 29 cm x 20 cm). **Weight:** 3.1 lbs. (1.35 kg).



BKP 3020 List $379.00 **Our Price $350.00**

- Four instruments in one package—sweep generator, function generator, pulse generator, tone-burst generator.
- Covers 0.02Hz - 2 MHz.
- 1,000:1 control each range.
- Low-distirtion high-accuracy outputs.
- Three-step attenuator plus vernier control.
- Tone-burst output is front-panel or externally programmable.

Waveforms: Sine, square, pulse, triangle ramp*, TTL square wave, tone burst, DC (*when variable symmetry used). **Modes:** Sweep, CW, A-M, F-M function, burst. **Frequency Range:** 0.2Hz to 2MHz in 7 ranges. **Accuracy:** ±5% of full scaie to 9.5MHz. ±8% of full scale from 1.5MHz to 2.0MHz. **Frequency Stability:** 0.5% after 15 minutes. **Main Generator Output:** Sine, square, triangle; switch selectable. **Output Amplitude:** 20 Vp-p open circuit. 10 Vp-p into 50Ω. **Variable Symmetry:** Variable over 1:1 to 40:1 range. **Internal Sweep:** Linear or logarithmic. **Internal Sweep Rate:** 20 ms to 2 s continuously variable. **Internal Sweep Width:** 1000:1, 3 decades linear or log. **Internal Sweep Output:** (f:V) approximately 0 to -2 V output for 1000:1 sweep. **External Sweep Input:** (V:f) approximately 0 to +10V input for 1000:1 frequency sweep. **Triggered Modes:** Accepts TTL level pulse as tone burst gate. Tone burst is an integral burst and gate signal available 20 ms to 2 s. **Square Wave Symmetry:** 99% to 100KHz. **Squaew Wave Rise/Fall Time:** <100 ns. **Sine Wave Distortion:** <1% 0.2Hz to 100KHz; harmonics <25 dB down from 100KHz to 2MHz. **Amplitude Flatness:** <±0.3 dB to 2MHz. **Triangle Wave Linearity:** >99% to 0.02Hz to 100KHz. **Sweep Pulse Output:** TTL compatible square wave. Additional features: a-m modulation, polarity. Normal or Inverted. **Operating Environment:** 0° to 50° C (accuracy specified at 25° ±5° C). **Power Requirements:** 105-130/210-260 VAC 50/60Hz 20 W. **Size (HWD):** 3.2" x 11.3" x 7.7" (8.1 c. x 29 c. x 20 cm). **Weight:** 3 lbs (1.40 kg).

BKP 3025 List $450.00 **Our Price $410.00**

- Generates sine, square, triangle and haversine waveforms.
- Covers 0.005Hz to 5MHz.
- Four decade, 10,000:1 log sweep range; 1,000:1 linear sweep range.
- Tone burst or single cycle operation.
- Sweeps up or down in frequency.
- Independent start and stop frequency controls for setting sweep limits.
- Variable dc offset.
- Separate high and low amplitude outputs, plus variable amplitude control.

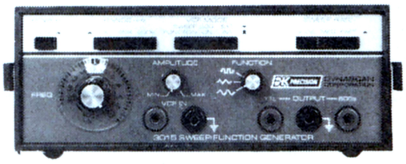
Waveforms: Sine, square, triangle, haversine. **Modes:** Continuous, linear sweep, logarithmic sweep, tone burst, single cycle. **Frequency Range:** 0.005Hz to 5MHz in 7 ranges, 1000:1 frequency control. **Accuracy:** ±5% of full scale. **Amplitude Stability:** 0.25% of setting after 15 minutes. **Frequency Stability:** 0.25% of setting after 15 minutes. **Main Generator Output:** Sine, square, triangle, haversine; selectable. **Output Amplitude:** 20 Vp-p into open circuit maximum, 10 Vp-p into 50Ω, 50Ω output impedance. **Attenuation:** Amplitude control provides 20 dB variable attenuation. Separate low output jack provides 20 dB attenuation of main output. **DC Offset and DC Output:** Available at 50Ω output. Continuously variable ±10 VDC into open circuit, ±7.5 VDC into 50Ω. **Internal Sweep:** Linear or logarithmic, sweep limit up to 3 decades linear (4 decades log). **Internal Sweep Rate:** 10 ms to 1 minute continuously variable. **Internal Sweep Width:** 1000:1 linear, 3 decades; 10,000:1 log, 4 decades. **Internal Sweep Output:** (f:V) Approximately 0 to +5V output for 1000:1 linear (10,000:1 log) frequency sweep range. **External Sweep Input:** (V:f) Approximately 0 to +5V input for 1000:1 linear (10,000:1 log) frequency sweep. **Triggered Modes:** 1.6V trigger input threshold or manual pushbutton. Single cycle—one complete cycle output per pulse trigger input. Tone burst—sustained output while trigger input applied (last cycle completed when trigger removed). **Square Wave Symmetry:** Better than 99% from 1Hz to 5MHz. **Square Wave Rise/Fall Time:** <50 ns. **Square Wave Overshoot:** <5% of peak voltage (50Ω termination). **Sine Wave Distortion:** Ω0.5% from 1Hz to 100KHz. All harmonics <k30 dB down from 100KHz to 5MHz. **Amplitude Flatness:** <±0.2 dB to 500KHz <1 dB to 5MHz. **Triangle Wave Linearity:** >99% from 0.1Hz too 100KHz. **Sweep Pulse Output:** TTL compatible square wave (approximately 5V peak). **Operating Environment:** Specifications valid at 25° ±5° C after 30 minutes. **Power Requirements:** 100/120/220/240 VAC, 50/60Hz, 25 KW. **Size (HWD):** 3.5" x 8.3" x 11" (8.9 cm x 21 cm x 28 cm). **Weight:** 5 lbs. (2.3 kg).

BKP 3010 List $220.00 **Our Price $205.00**

WT. 51 lbs.

- Generates sine, square and triangle waveforms.
- Variable amplitude and fixed TTL square-wave outputs.
- 0.1Hz to 1MHz in six ranges.
- Typical sinewave distortion under 0.5% from 1Hz to 100KHz.
- Variable dc offset for engineering applications.
- VCO external input for sweep tests.

Waveforms: Sine, square, triangle, dc, TTL square wave. **Frequency Range:** 0.1Hz to 1 MHz in 6 ranges. **Accuracy:** ±5% of full scale to 500KHz, ±8% of full scale from 500KHz to 1MHz. **Frequency Stability:** 0.5% after 15 min. **Main Generator Output:** Sine, square, triangle; selectable. **Output Amplitude:** 20 V-p open circuit, 10 Vp-p into 600Ω. **Attenuation:** Amplitude control provides 30 dB variable attenuation. **DC Offset and DC Output:** Available at 600Ω output. Continuously variable ±10VDC into open circuit, ±5 VDC into 600Ω. **External Frequency Input:** (V:f) approximately 0 to +5.5V input for 100:1 frequency change. **Square Wave Symmetry:** Greater than 99% to 100 KHz. **Square Wave Rise/Fall Time:** 100 ns. **Sinewave Distortion:** 1% from 1Hz to 100KHz, harmonics 30 dB down from 100KHz. **Amplitude Flatness:** ±0.3 dB to 1MHz. **Triangle Wave Linearity:** 99% from 0.1Hz to 100KHz. **Operating Environment:** 0° to 50°C (accuracy specified at 25° ±5°C). **Power Requirement:** 105/130/210/260 VAC, 50/60 Hz, 8 W. **Size: (HWD):** 3.2" x 11.3" x 7.7" (8.1 cm x 28.7 cm x 19.6 cm). **Weight:** 2.9 lbs. (1.3Kg).



AMPLITUDE
FUNCTION
FREQ
MIN
MAX
VCF IN
OUTPUT
B+K PRECISION DYNASCAN CORPORATION
3015 SWEEP/FUNCTION GENERATOR

BKP 3015 List $270.00 **Our Price $255.00**

WT. 5 lbs.

- Generates sine, square and triangle waveforms.
- 2Hz to 200KHz frequency coverage.
- Internal lin/log sweeps with selectable sweep rate.
- 1,000:1 frequency ratio in three decades.
- Variable amplitude and fixed TTL outputs.
- 2Hz to 200KHz frequency coverage.

Waveforms: Sine, triangle, square. **Modes:** Continuous, linear sweep, log sweep. **Frequency Range:** 2Hz—200KHz in 3 ranges. **Accuracy:** ±5% full scale to 20KHz. **Main Generator Output:** Sine, square, triangle (selectable) 15 Vp-p—open circuit; 7.5 Vp-p—600 Ohms. **Attenuation:** 30 dB; continuously variable. **External Frequency Input:** (V:f) approximately 0 to +1V for 1000:1 frequency change. **Square Wave Symmetry:** Greater than 99% to 100KHz. **Sine Wave Distortion:** <1% 2Hz to 20KHz. **Triangle Wave Linearity:** Greater than 99% to 100KHz. **Internal Sweep:** Linear 1000:1 Log 10,000:1 **Internal Sweep Rate:** Selectable: Slow—25 s; Medium—250 ms; Fast—2.5 ms. **Auxiliary Outputs:** (f:V) 1. Sweep—voltage proportional to frequency; 2. Ramp Sync—1 Vp-p minimum; 3. TTL—3 Vp—minimum. **Auxiliary Inputs:** 1. Ramp timing—use ext. cap for extended range; 2. V:f—1V for 1000:1 change in frequency. **Operating Environment:** 0° to 50° C. **Power Requirements:** Supplied with 120 VAC or 220 VAC adapter. **Size (HWD):** 2⅞" x 7⅜" x 8½" (7.3 cm x 18.7 cm x 21.6 cm). **Weight:** 2 lbs. (0.9 kg).

555 TIMER APPLICATIONS SOURCEBOOK, WITH EXPERIMENTS *by Howard M. Berlin.* Deals with the many applications of the popular 555 timer "chip." Uses for voltage regulation, control, sequencing are covered as well as the more usual timing and signal generating functions. 160 pages; 5½ x 8½; softbound.

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DESIGN OF TRANSISTOR CIRCUITS, WITH EXPERIMENTS *by Keats A. Pullen.* Dr. Pullen has written a self-teaching course to provide the reader with the background and explanations necessary to design transistor circuits. 512 pages; 5½ x 8½; softbound.

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DESIGN OF PHASE-LOCKED LOOP CIRCUITS WITH EXPERIMENTS *by Howard M. Berlin.* The design of the basic PLL circuits is described; detector, phase comparator, and voltage-controlled oscillator circuits are detailed. 256 pages; 5½ x 8½; softbound.

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Note:
1. All electrical Tools & Components are UL Listed and bear the mark. Rated at 120 Volts AC/DC.
2. All Temperature Ranges are Approximate.
3. Tip not included.
4. Use UNG Iron holder for best results.

MODEL 7500 GROUNDED 3 WIRE HANDLE

The UNG 7500 handle, when assembled with the "S" or "HP"™ Series heater, is completely grounded from tip to plug. Flexible 3 wire heat resistant cord and spring loaded, heat/reflecting ground plate. USE ONLY WITH S OR HP HEATERS.

UNG 7500 .... **$11.83**

MODEL 7770 BLUE CLEAN ROOM HANDLE

Molded lightweight handle features cool flux and acid resistant grip. Includes cord protector and flexible cord set. Handles accept all Standard Line heaters and integral heater/tips.

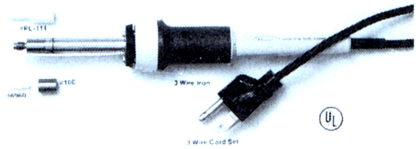
UNG 7770 .... **$5.92**

S SERIES STAINLESS STEEL HEATERS

Constructed of corrosion-resistant stainless steel. 2- or 3-wire versatility. Models 537-S, 1237-S and 4037-S Thread-On Heaters will accept all ¼" Thread-On Tips and, with No. 100 Adapter, all ⅛" Thread-in Tiplets and Nibs, with No. 101 Adapter, all 3/16" Thread-in Tips.

PART NO.	TEMP.	WATTS	PRICE
UNG537-S	Approx. 700	23	**$6.42**
UNG1237-S	Approx. 800	33	**$7.70**
UNG4037-S	Approx. 900	45	**$9.75**

3-WIRE LINE

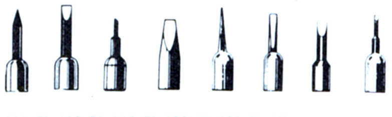


The ultimate tool . . . approved grounding ensures maximum safety from static-induced currents to sensitive circuitry. Meets NASA/military standards plus gives you the versatility of more than 40 tips, tiplets, nibs, and three fast-change heater units. Handle up to 30 cooler. New heat resistant cord set. Use ¼" thread-on tips or adapters.

COMPLETE 3-WIRE IRON

PART NO.	DESCRIPTION	SUGGESTED USER PRICE
UNG1270	Handle, 650 - 750 F., 27W	**$17.77**
UNG1350	Handle, 750 - 850 F., 35W	**$17.77**
UNG1450	Handle, 900 - 1000 F., 45W	**$17.77**

IRON CLAD AND SILVER PLATED ¼" THREAD-ON TIPS AND ADAPTERS



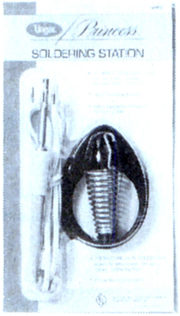
Part No.	Tip Shape ¼" Thread-on Tips	Ovrl. Lgth	Tip Diam.	Price
UNGPL111	Pencil	1-1/4	1/8	**$2.15**
UNGPL113	Chisel	1-1/4	1/8	**$2.15**
UNGPL114	Micro spade	1	.05	**$2.15**
UNGPL133	Taper chisel	1-1/16	1/8	**$2.22**
UNGPL138	Needle	1-1/4	3/64	**$2.15**
UNGPL151	Screwdriver	1-1/4	1/8	**$2.15**
UNGPL153	Chisel	1-1/16	3/16	**$2.15**
UNGPL155	Stepped chisel	1-1/4	1/16	**$2.15**

ADAPTERS

UNG100	¼" thread-on heaters to ⅛" thread-in tips	**$.72**
UNG101	¼" thread-on heaters to 3/16" thread-in tips	**$.72**

PRINCESS® MICRO LINE

- Designed expressly for the special needs of micro-electronic assembly.
- This popular precision tool design enables pinpoint hand control, comfort, and accuracy assuring high-yield soldering of delicate circuitry and components in the tightest spaces.



PRINCESS KIT

- Complete Princess iron with 3 interchangeable copper nibs.
- Includes #6902 2-wire handle, #6910 10W heat capsule, and #6950, #6951, and #6952 soldering nibs.

UNG6975	1 lb	**$24.97**

PRINCESS SOLDERING STATION

- Complete 10W soldering
- Fully assembled iron with 3 copper nibs plus Princess iron holder and cleaning sponge.
- Includes #6902 2-wire handle, #6910 10W heat capsule, and #6950, #6951, #6952 nibs, and #6990 iron holder and sponge.

UNG6900	1 lb	**$34.12**

HANDLES

- Nylon turquoise
- Plastic cool-grip, plug & cord

UNG06902	2-wire plug	**$10.42**
UNG06903	3-wire plug	**$13.64**

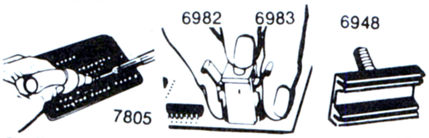
HEAT CAPSULE FOR ⅛" NIBS AND TIPLETS

UNG6918	775 -850 F. 18W	**$12.24**

⅛" IRON CLAD AND GOLD PLATED PRINCESS NIBS

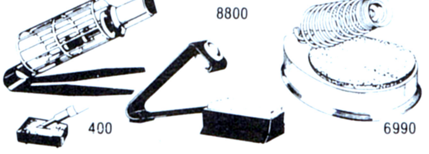
Part No.	Tip Shape	Ovrl. Lgth.	Tip Diam.	Price
UNG6960	Pencil	3/8	1/16	**$1.85**
UNG6961	Screwdriver	7/16	1/16	**$1.85**
UNG6962	Spade	3/8	1/16	**$1.85**
UNG6963	Precision	3/8	1/16	**$3.32**
UNG6953	Precision	3/8	1/16	**$1.85**

DE-SOLDERING EQUIPMENT



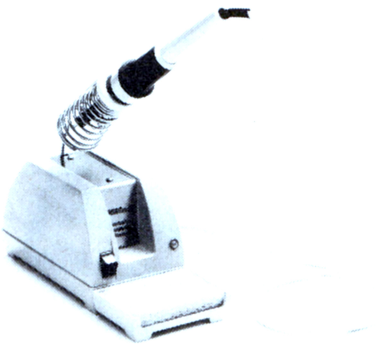
Part No.	Description	Price
UNG50 DK	Ungarmatic™ Desoldering Kit. Adapts for fast, easy removal of 14 and 16 pin DIP's. Kit includes 95 Tip Adapter, 6982 Extractor, 6948 Bar Tip, 5013 Super-Wick Desoldering Braid	**$14.40**
UNG51 DK	Desoldering Kit. Same as above. With 100 Adapter, fits Ungar Heaters. Standard 1237-S, 4037-S, 37 H.P. 3-wire 1350, 1450	**$12.95**
UNG6980	DIP Extractor Pliers	**$16.17**
UNG6982	Dual In-Line Extractor. Removes up to 16 pin IC's, use 6948 desolder tip.	**$ 4.88**
UNG6983	TO-5 Extractor, for most TO type cans, use desolder tips: 6943, 6944, 6946	**$ 4.87**
UNG6948	Desolder Tip, for DIP's, Iron Clad, pre-tinned	**$ 5.78**
UNG7805	Solder-Off Bulb with TEE tip.	**$ 3.33**

PRODUCTION AIDS

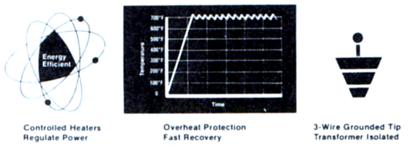


Part No.	Description	Price
UNG8000	Iron Holder. All Irons	**$ 5.65**
UNG6990	Iron Holder, for Princess Iron only	**$ 9.14**
UNG8800	Iron Holder. All Irons plus Ungarmatic and Hot Vac 2000	**$10.99**
UNG400	Kleen-Tip Sponge & Tray, fastens to workbench, sponge replaceable	**$ 3.07**
UNG455	Replacement sponge	**$ 1.20**

Ungar® UNGARmatic®

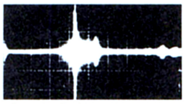


Controlled Soldering Station


Energy Efficient
700°F
600°F
500°F
400°F
300°F
200°F
100°F
0
Temperature
Time
Controlled Heaters Regulate Power
Overheat Protection Fast Recovery
3-Wire Grounded Tip Transformer Isolated

THREAD-TOGETHER MODULAR DESIGN FOR QUICK, ON-LINE HEATER OR TIP CHANGE

- Available in 3 preset temperatures: 600 F, 700 F or 800 F for any application.
- Closed loop, non-magnetic control.
- Low voltage system: 3 wire grounded.
- Biomechanical designed handle with cool grip for operator comfort. Cord is super flexible 3 wire grounded, heat resistant.
- Large capacity snap-on tray and sponge: removable for optional placement.
- Long life interchangeable tips: iron clad, chrome plated, pre-tinned.
- Designed for use on sensitive components



Competitor 27v Spike — Scale: 10v/grad.

UNGARmatic® 3v Spike — Scale: 10v/grad.

Transient spikes caused by the switching action of some controlled output soldering stations may be transmitted to the workpiece and may adversely affect a metal oxide semiconductor, particularly if the amplitude of that spike is in excess of the operating voltage of the device. UnGARmatica Temperature Controlled Soldering Stations and Irons suppress transient spikes to less than the 5 volt operating voltage of sensitive MOS devices.

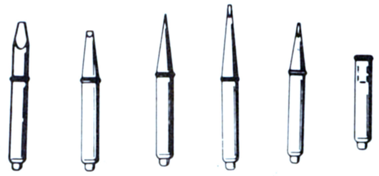
COMPLETE STATON SELECTION GUIDE

FOR THIS TEMPERATURE		ORDER COMPLETE STATION PART #
600 F		**UNG50T6**
700 F	(MOST POPULAR)	**UNG50T7**
800 F		**UNG50T8**

LIST PRICE: $82.80

OUR PRICE: $74.52

Each of the above stations include: #70B Power Supply with on/off switch, indicator light, and 3 wire power cord; #71 Handle with 3 wire heat resistant secondary cord; #89 Tray and Sponge; #72 Iron Holder; Controlled Heater with #87 Screwdriver tip 1/16".



UNG #80 UNG #83 UNG #86 UNG #88 UNG #93 UNg #95

Iron clad, chrome plated, pre-tinned tips.

UNG80	Long Screwdriver ⅛"	**$2.97**
UNG83	Screwdriver 3/32"	**$2.97**
UNG86	Needle Tip 3/64"	**$2.97**
UNG88	Long Screwdriver 3/64"	**$2.97**
UNG93	Screwdriver 1/32"	**$2.97**

UNG #95 TIP ADAPTER Tip Adapter #95 for special micro applications. This Adapter is designed for the use of ⅛" thread-in Princess Nibs **$1.70**

SUPER-WICK™ DESOLDERING BRAID

CAT. #	WIDTH	PRICE
UNG5002	.050"	**$1.78**
UNG5004	.100"	**$2.03**

PLEASE ORDER BY PART NUMBER

Hot Vac® Desoldering Systems

Ungar.

IOT VAC Model 2000A is the conomical, no-compromise, non-nagnetic desoldering system de-igned for use with shop air

- A solid-state control adjusts tip temperatures from 500 to 1000 F
- The load modulated heater assures instantaneous recovery
- Transient spikes are fully suppressed
- The continuous, high flow vacuum is actuated by a switch conveniently built into the handle
- Biomechanically designed handle reduces fatigue and increases productivity

	LIST PRICE	OUR PRICE
ING4000	$399.00	$375.00

ip Cleaning Tool #2002, Kleen-Tip Sponge and Tray #400, and #2039 Pack of 10 Filters.

	LIST PRICE	OUR PRICE
ING4000 10 lbs.	$399.00	$375.00
ING2000A	$339.00	$320.00
same as above except uses shop air)		

Ungar®

HEAT GUN

Specifically built for electronic assembly, the ⅜" nozzle enables precise, accurate heat flow (750°-800° F.) for a variety of applications including shrink tubing, curing cements, reflow soldering, cooling/drying, encapsulation, shrink films, and component stressing. Four baffle adapters standard with heat guns for complete versatility. Weighs 13 oz. Convenient 3-way switch. Case of UL recognized glass filled plastic. #6966C complete with 3-wire NEMA plug for approved grounding. 4 baffle adapters standard.

PART NO.		PRICE
UNG-6966C	SH.WT. 3 LBS.	$65.00

cfc COLE-FLEX CORPORATION

IRRADIATED POLYOLEFIN SHRINKABLE TUBING

- Conforms to MIL-I-23053B/5
- Shrinks 50% (2:1 ratio) with only 5% longitudinal shrinkage
- Fewer sizes covering more applications
- Operating temp. range: -55°C to + 135°C
- Dielectric strength: 500 u per mil

art No.	Size	Price 4 ft. Length	100 Ft. (25 x 4 ft. Lengths) Add "C" to end of Part No.
CST364XX	3/64"	$1.05	$22.36
CST116XX	1/16"	$1.10	$23.83
CST332XX	3/32"	$1.25	$27.04
CST18XX	18"	$1.30	$28.59
CST316XX	3/16"	$1.60	$34.73
CST14XX	1/4"	$2.00	$43.94
CST38XX	3/8"	$2.25	$48.94

Vhen Ordering—Replace "XX" with color code: Color Codes: 3K-Black, WH-White, RD-Red, YE-Yellow, BU-Blue, CL-Clear.

ADEL NIBBLING TOOL

This Nibbling Tool is perfect for cutting, trimming, or notching sheet metal up to 18 gauge.

It operates like a punch and die and also works well on aluminum or plastic up to 1/16" thick. We feel that this tool can be a real time-saver for our customers when working on chassis, printed circuit boards and proto-type model boards.

TLX201	NIBBLING TOOL	$8.95

KESTER SOLDER

60% TIN 40% LEAD ROSIN CORE
SOLDER – PRICE PER SPOOL

PART NO.	DISC		1-4	5-9	10-24
KST240018	.025 dia.	1 lb.	15.02	14.27	12.77
KST230027	.031 dia.	½ lb.	8.64	8.20	7.40
KST240027	.031 dia.	1 lb.	14.38	13.66	12.22
KST240053	.050 dia.	1 lb.	13.54	12.86	11.51

ISO-TIP®

Cordless Soldering Irons

- Up to 125-150 Joints per charge
- 5-10 Seconds average soldering heat time
- Tip performance up to 50 watts and over 700°F tip temperature
- Built-in work light
- "Lock off" switch
- Rechargeable battery & charger included
- Cannot over charge

IS07800	Fastest recharging iron on the market. Recharges fully in one hour.	$42.50
IS07740	"Quick Charge" Recharges completely in 3 to 4½ hours	$31.50
IS07540	"The Original" Recharges completely in 12 to 16 hours	$27.80
IS06500	P.C. Drill attachment with No. 56 Bit.	$11.95

EDSYN INC®

PORTABLE DESOLDERING TOOLS

wt. 4 oz. (113g)

Special purpose SOLDAPULLT for low static work stations. Deluxe features. Static conductive construction reduces sensitive component damage.

EDSAS196 .... **$21.95**

wt. 4 oz. (113g)

DELUXE

Rugged manual loading tool for volume desoldering. High vacuum. Hevy duty plastic. Fully enclosed shaft for safety. Plunger lock feature for compact storage.

EDSDS107 .... **$17.95**

wt. 3 oz. (85g)

Sturdy tool for routine desoldering. Slim profile, smooth action, very low recoil. Plunger lock feature for compact storage.

EDSPT109 .... **$12.50**

wt. 1.6 oz. (45g)

LOW STATIC POTENTIAL

Completely portable. One hand loading, three position stroke adjustment. Swift vacuum action.

EDSUS340 .... **$11.95**

wt. 1.6 oz. (45g)

Compact manual loading tool. Easy one hand operation. Adjustable three position loading stroke. Low mass plunger, rapid vacuum impulse, negligible recoil.

EDSUS140 .... **$ 8.95**

wt. 7 oz. (20g)

MINI VACUUM PUMP

Designed for desoldering microminiature components and fine wiring. Resillient teflon tip, spring arrestor plunger with cleaning shaft.

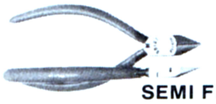
EDSMV124 .... **$ 5.95**

REPLACEMENT TIP FOR SOLDAPULLTS

CAT.#	TOOL USED	PRICE
EDS-SRT12	DS017, PT109, US140	$2.95
EDS-LS197	AS196,US340	$4.50
EDS-EC131	MV124 (END CAP)	$1.95
EDS-ST132	MV124 (TIP)	$1.95

HUNTER TOOLS

ONE



DIAGONAL CUTTERS

SEMI FLUSH

PART NO.	LENGTH	MAX. WIRE SIZE	PRICE
HNT20197	4 1/8"	20GA	$12.89
HNT20186	4 3/4"	18GA	$13.73

FULL FLUSH

PART NO.	LENGTH	MAX. WIRE SIZE	PRICE
HNT20195	4 1/4"	20GA	$13.26
HNT20177	3 13/16"	24GA	$11.85

TIP DYKE-SEMI FLUSH

PART NO.	LENGTH	MAX. WIRE SIZE	PRICE
HNT20190	4 3/4"	22GA	$21.10

CHAIN NOSE PLIERS

MINIATURE

PART NO.	LENGTH	SERRATED	PRICE
HNT20144	4 1/4"	NO	$13.10

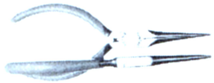
CURVED

PART NO.	LENGTH	SERRATED	PRICE
HNT21029	4 1/2"	NO	$15.49

NARROW

PART NO.	LENGTH	SERRATED	PRICE
HNT20150	4 3/4"	YES	$11.05

NEEDLE NOSE PLIERS



EXTRA LONG

PART NO.	LENGTH	SERRATED	PRICE
HNT20105	5 5/8"	YES	$11.99

SUPER THIN

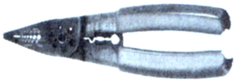
PART NO.	LENGTH	SERRATED	PRICE
HNT20114	4 3/4"	NO	$11.72
HNT20115	6"	NO	$12.66

STRAIGHT NOSE FORCEP CLAMP

FORCEP CLAMP (Hemostat, Forcep) Popular in the electronics field with applications throughout the industry. Clamps, holds, and positions small parts; wires, pins, etc. **HNT54035 5" Model $7.10**

WIRE STRIPPERS AND CUTTERS

HNT25504



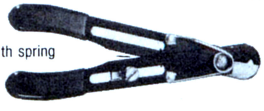
5 IN 1 Plier, diagonal cutter, screw cutter, crimper and stripper.

$9.57

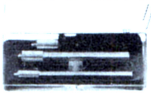
HNT25508

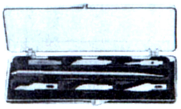
Stripper and Cutter with spring

$3.41



KNIFE SETS





HEAVY DUTY KNIFE SET includes three knives, regular #50130, heavy duty #50160, and extra heavy duty #50170, plus 10 assorted blades.

HNT50182 .... **$7.10**

PRECISION KNIFE SET Popular set both in industry and with the hobbyist. Complete with two most popular handles, #50130 and #50160 plus 10 assorted blades.

HNT50183 .... **$5.02**

SCREWDRIVERS

PART NO.	BLADE D" x L"	PRICE
HNT30310	1/8 x 2	$1.15
HNT30316	1/8 x 4	$1.29
HNT30304	1/4 x 4	$2.59
HNT30306	1/4 x 6	$2.69
HNT30344	5/16 x 6	$3.00
HNT30330	3/16 x 4	$1.98
HNT30332	3/16 x 6	$2.10
HNT30402	1½x4 x 1½	$2.10

PHILLIPS

PART NO.	TIP	L"	PRICE
HNT30502	#0	2	$1.89
HNT30510	#1	3	$1.65
HNT30512	#2	4	$2.59
HNT30514	#3	6	$3.50
HNT30506	#2	1½	$2.10

5 PIECE HEAVY DUTY SCREWDRIVE KIT - 30316, 30330, 30304, Phillips: 30510, 30512. **HNT31802 $10.31**

HEX NUT DRIVERS

BLADE LENGTH - 3"
STUD CLEARANCE - 1¼"

PART NO.	HEX SIZE"	PRICE
HNT33005	3/16	$2.30
HNT33010	7/32	$2.30
HNT33015	1/4	$2.30
HNT33020	9/32	$2.30
HNT33025	5/16	$2.30
HNT33030	11/32	$2.30
HNT33035	3/8	$2.30

NUT DRIVER KIT 7 most popular sizes (3/16", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8") regular nut-drivers – heavy duty vinyl kit.

HNT32086 .... **$15.87**

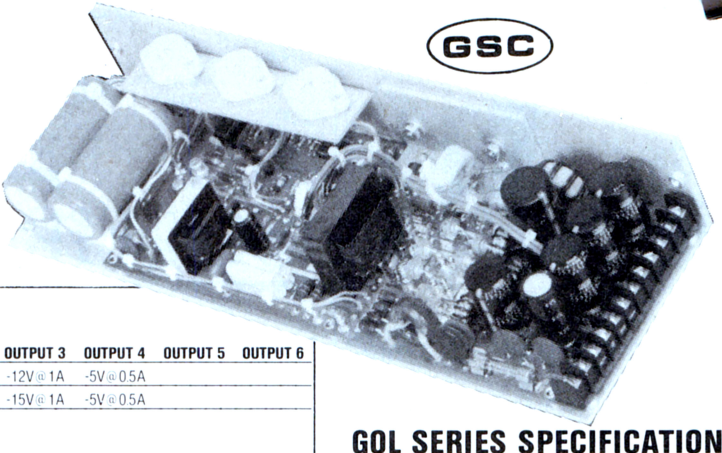
VISIT OUR RETAIL SHOWROOM

GOL Series Multiple Output Switchers

ONE

LAST YEAR, GSC SHIPPED OVER $10 MILLION OF THESE STANDARD SWITCHERS...THAT JUST MIGHT MAKE GSC THE BIGGEST POWER SUPPLY COMPANY YOU NEVER HEARD OF.

GSC



GOL50LP SERIES

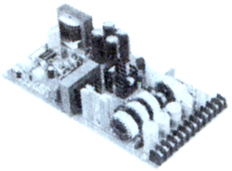
MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL50LP	+5V@6A	+12V@1A	-12V@1A	-5V@0.5A		
GOL51LP	+5V@6A	+15V@1A	-15V@1A	-5V@0.5A		

DIM: 6.25 x 4.25 x 2.0 Weight: 1 lb. **$119.00**

GOL 75LP SERIES

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL75LP	+5V@8A	+12V@1.5A	-12V@1.5A	-5V@1A		
GOL76LP	+5V@8A	+15V@1.5A	-15V@1.5A	-5V@1A		

DIM: 7.75 x 4.25 x 2.0 Weight: 1.6 lbs. **$139.00**



GOL 100LP SERIES

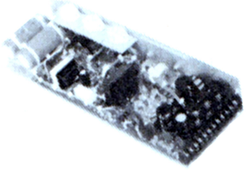
MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL100LP	+5V@10A	+12V@3A	-12V@3A	-5V@2A	+24V@2A	
GOL101LP	+5V@10A	+15V@3A	-15V@3A	-5V@2A	+24V@2A	

DIM: 9.45 x 5.0 x 2.0 Weight: 1.8 lbs. **$179.00**

GOL150LP SERIES

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL150LP	+5V@15A	+12V@4A	-12V@4A	-5V@2A	+24V@4A	
GOL151LP	+5V@15A	+15V@4A	-15V@4A	-5V@2A	+24V@4A	
GOL150LP2	+5V@4A	+12V@4A	-12V@4A	-5V@2A	+36V@4A	
GOL151LP2	+5V@15A	+15V@4A	-15V@4A	-5V@2A	+36V@4A	

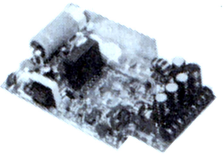
DIM: 13.6 x 4.8 x 2.6 Weight 3.4 lbs. **$229.00**



GOL200LP SERIES

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL200LP	+5V@25A	+12V@6A	-12V@6A	-5V@4A	+12V@4A	
GOL201LP	+5V@25A	+15V@6A	-15V@6A	-5A@4A	+24V@4A	
GOL200LP2	+5V@25A	+12V@6A	-12V@6A	-5V@4A	+36V@4A	
GOL201LP2	+5V@25A	+15V@6A	-15V@6A	-5V@4A	+36V@4A	

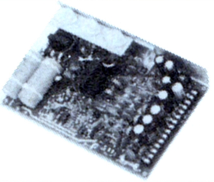
DIM: 15.0 x 4.95 x 2.5 Weight: 4.0 lbs. **$269.00**



GOL200S

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL200(S)	+5V@25A	+12V@4A	-12V@4A	+24V@4A		
GOL201(S)	+5V@25A	+15V@4A	-15V@4A	+24V@4A		
GOL200(S)2	+5V@25A	+12V@4A	-12V@4A	+36V@4A		
GOL201(S)2	+5V@25A	+15V@4A	-15V@4A	+36V@4A		

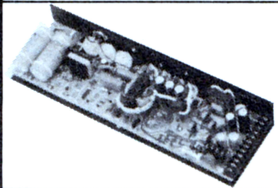
DIM: 15.0 x 4.95 x 2.5 Weight 4.0 lbs. **$269.00**



GOL 300 SERIES

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL300	+5V@30A	+12V@4A	-12V@4A	+24V@4A	+15V@4A	-15V@4A
GOL3002	+5V@30A	+12V@4A	-12V@4A	+36V@4A	+15V@4A	-15V@4A

DIM: 11.75 x 7.62 x 2.5 Weight: 4.5 lbs. **$389.00**



GOL400LP SERIES

MODEL	OUTPUT 1	OUTPUT 2	OUTPUT 3	OUTPUT 4	OUTPUT 5	OUTPUT 6
GOL400LP	+5V@45A	+12V@10A	-12V@10A	-5V@4A	+24V@4A	
GOL401LP	+5V@45A	+15V@10A	-15V@10A	-5V@4A	+24V@4A	
GOL400LP2	+5V@45A	+12V@10A	-12V@10A	-5V@4A	+36V@4A	
GOL401LP2	+5V@45A	+15V@10A	-15V@10A	-5V@4A	+36V@4A	

DIM: 16.87 x 5.2 x 2.5 Weight: 5.0 lbs. **$479.00**

GOL SERIES SPECIFICATIONS:

DC OUTPUT

Line Regulation	0.2% over entire input range.
Load Regulation	0.2% from no load to full load for 5 Volts outputs only. ±2.5% from 20% load to full load for all other outputs.
Minimum Load	Zero. For 50 LP, 75 LP and 100 LP maximum of 10% of rated load on 5V output is required.
Ripple and Noise (Pard)	60Hz Component-0.4% all outputs. Switching Frequency Component-less than 10mV all outputs.
Temperature Coefficient	±0.02%/ C.
Efficiency	Up to 80%...70% Minimum.
Hold-up Time	Supply remains in regulation for a minimum of 20 msec after removal of nominal AC power.
Polarity	Return terminals may be grounded for left floating up to 400V DC with respect to chassis ground.

AC INPUT

Line	95-130V AC or 190-260V AC. 47-440Hz Strappable (except 200 (S) Series).
Efficiency	Up to 80%...70% Minimum.
Inrush Current	The AC input inrush current is limited by a negative temperature coefficient thermistor.

OVERSHOOT

No overshoot on turn on, turn off or power failure.

SLEW RATE RESPONSE

2% maximum deviation for a 50% load change at 5A/u sec.

OVERLOAD PROTECTION

Non reentrant shutdown results when a power level exceeding 115-130% of the maximum rated output level is reached. Shutdown will also occur in response to the presence of an overvoltage condition on the 5 Volt output. Shutdown results in all output levels dropping to 0 volts. Internal failure protection provided by fuse.

OVERVOLTAGE PROTECTION

Standard on 5 Volt output set at 6.5 Volts ±0.3 Volts

AMBIENT OPERATING TEMPERATURE

Continuous duty 0 to 70 C ambient derate power ratings linearly from 100% @ 40 C to 50% @ 70 C

STORAGE TEMPERATURE

-30 C to +85 C

COOLING

Convection cooled

INPUT & OUTPUT CONNECTIONS

Input	Via terminal block.
Output	Via terminal block.

ISOLATION

15 megohm minimum, at 1500V AC

MOUNTING

True 2 surface mounting all models.

RFI FILTERING

Independent LC section on each side of the AC line.

PHYSICAL DATA

Size	As indicated by model number.
Construction	Rugged ⅛ aluminum chassis

GUARANTEE

2 year warranty

APPROVALS

under UL 478
under data processing equipment

GSC power supplies sell faster than we can stock our shelves. Please plan ahead and allow 2-4 weeks for delivery.

CALL FOR QUANTITY PRICING

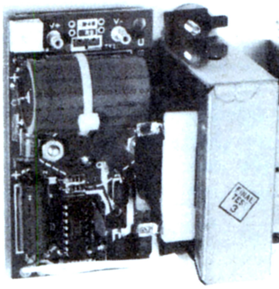
PRIORITY ONE ELECTRONICS

OPEN FRAME POWER SUPPLIES

GSC

Basic features of all GOF Series units include: dual AC primary hookup for 115/230 VAC connection with 50Hz provision; oversize lo-flux transformers; pluggable IC regulators. 85 computer-grade electrolytics; metal-can power transistors. FR-4 circuit boards with 2 oz. copper track; remote sensing fold back current limiting; multi-surface mounting with factory-installed captive hardware; industry standard frame size for simplified alternative sourcing.

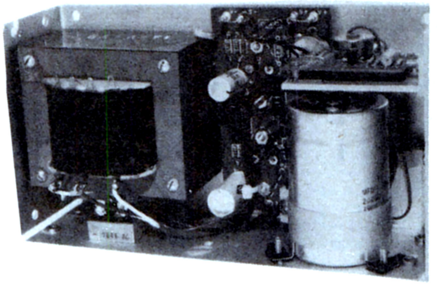
Premium components are used in all units to enhance reliability. All IC regulators are pre-burned and checked before installation in actual units. IC's are socket mounted and user replaceable. Computer-grade capacitors are rated to 85 operating levels and are built to GSC's own specifications for low ESR to enhance long life. All power transistors are metal-can devices and are graded for important parameters by GSC's own quality assurance group before release to production.



GOF MIDGET SERIES: $26.78

GOFM-5	5V/1.2A
GOFM-12	12V/0.5A
GOFM-15	15V/0.5A
GOFM-24	24V/0.4A
GOFM2-6	2 to 6V/1A
GOFM10-16	10 to 16V/1A
GOFM16-24	16 to 24 v/1A

Dim: 1.9" x 4.0" x 4.0"
Weight: 3 lbs.



GOF-3 SERIES: $76.22

GOF3-5	5V/12A
GOF3-12	12V/8.0A
GOF3-15	15V/6.6A
GOF3-24	24V/4A
GOF3-28	28V/3.5A

Dim: 2.75" x 9.0" x 4.87"
Weight: 8 lbs.

GOF-3X SERIES: $91.67

GOF3X-5	5V/15A
GOF3X-12	12V/10A
GOF3X-15	15V/8A
GOF3X-24	24V/6.5A
GOF3X-28	28V/4.5A

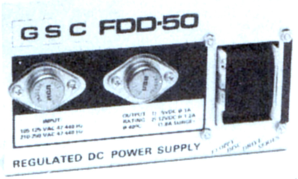
Dim: 2.75" x 9.0" x 4.87"
Weight: 10 lbs.

Overvoltage Protection Modules

GOFOVF-1		
GOFOVF-1	Below 6A	**$ 8.50**
GOFOVF-2	6A to 10A	**$12.50**
GOFOVF-3	15A to 25A	**$25.25**

Weight: 1 lb.

FEATURES:
- Designed to comply with all applicable UL & CSA specifications!
- Pluggable IC regulators - user replaceable!
- Remote sensing!
- Fold back currents limiting!
- Unconditionally guaranteed for two years!
- Manufactured and serviced in U.S.A. and Canada!
- Industry standard frame sizes for simplified second sourcing!



FOR 5¼ INCH DRIVES

GOFFDD-50 $58.71

GOFFDD-50	5V/1A	12V/1.2A

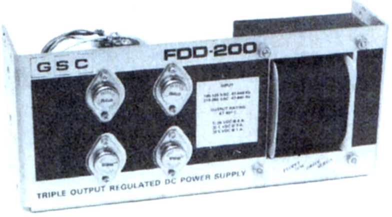
Dim: 2.13" x 6.5" x 4.13"
Weight: 3 lbs.

FOR 8 INCH DRIVES

GOFFDD-100 SERIES: $91.67

GOFFDD100	24V/2A	5V/1.5A	5V/5A
GOFFDD101	12-15V/1A	5V/3A	12-15V/1A
GOFFDD102	24V/2A	5V/3A	12-15V/1A

Dim: 2.80" x 10.25" x 4.00"
Weight: 6 lbs.



FOR DUAL 8 INCH DRIVES

GOFFDD-200 $118.45

GOFFDD200	5V/3A	24V/4.0A	5V/1.0A

Dim: 2.78" x 11.00" x 4.87"
Weight: 12 lbs.

GOF-1 SERIES: $37.08

GOF1-5	5V/3A
GOF1-12	12V/1.5A
GOF1-15	15V/1.2A
GOF1-24	24V/0.8A
GOF1-28	28V/0.5A

Dim: 1.62" x 4.00" x 4.87"
Weight: 5 lbs.

GOF-4 SERIES: $128.75

GOF4-5	5V/18A
GOF4-12	12V/12A
GOF4-15	15V/9.8A
GOF4-24	24V/6.1A
GOF4-28	28V/5.2A

Dim: 2.78" x 13.00" x 4.87"
Weight: 15 lbs.

GOF 2A-1D SERIES: $70.04

GOF2A-1D A	12-15V/1.5A	
GOF2A-1D B	5V/1.2A	5V/1.2A
GOF2A-1D c	5V/1.2A	15V0.5A
GOF2A-1D D	5V/1.2A	24V/0.4A

Dim: 2.53" x 7.90" x 4.03"
Weight: 5 lbs.

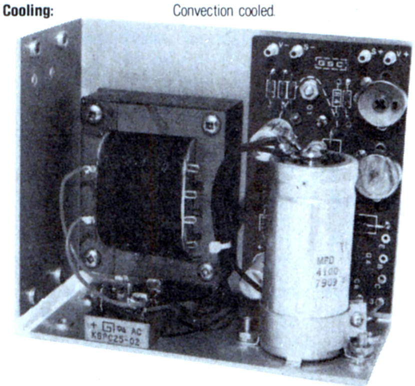
GOF 2A IT SERIES: $118.45

GOF2A-1T	5V/6A 12-15V/1.5A	12-15V/1.5A
GOF2A-1T A	5V/6A 12-15V/1.5A	5V/0.8A
GOF2A-1T b	5V/6A 12-15V/1.5A	18-24V/1.0A

Dim: 2.78" x 11.00" x 4.87"
Weight: 12 lbs.

SPECIFICATIONS:
Input:

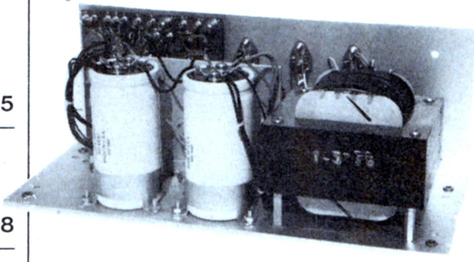
Input:	105-125 VAC/210-250 VAC, 47-63Hz.
Line Regulation:	0.5% over entire operating range.
Load Regulation:	0.1% for no load to full load current.
Output Ripple & Noise:	1 mV RMS/3 mV peak-to-peak typical.
Remote Sensing:	On all models except GOF-M series, FDD100 and GOF 2A-1D.
Transient Response:	No overshoot or undershoot on turn-on or turn-off.
Overload Protection:	Foldback current limited, self restoring.
Ambient Operating Temp:	Continuous duty from 0°C to 60°C
Mounting:	Multi-surface mounting with 8-32 captive hardware.
Cooling:	Convection cooled.



GOF-2 SERIES $58.71

GOF2-5	5V/6A
GOF2-12	12V/3A
GOF2-15	15V/2.8A
GOF2-24	24V/2.3A
GOF2-28	28V/2.0A

Dim: 2.5" x 4.87" x 5.62"
Weight: 5 lbs.



GOF-5 SERIES: $144.20

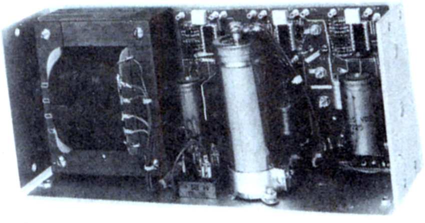
GOF-5	5V/25A
GOF5-12	12V/16A
GOF5-15	15V/13A
GOF5-24	24V/8.1A
GOF5-28	28V/6.9A

Dim: 5.0" x 13.25" x 4.88"
Weight: 15 lbs.

GOF 2A-2D SERIES: $92.70

GOF2A-2D A	12-15V/3A	12-15V/3A
GOF2A-2D B	5V/6A	5V/6A
GOF2A-2D C	5V/6A	12-15V/3A
GOF2A-2D D	5V/6A	24V/2.3A

Dim: 2.78" x 11.00" x 4.87"
Weight: 10 lbs.



GOF 3A IT SERIES: $149.35

GOF3A-1T A	5V/12A	12-15V/3A	12-15V/3A
GOF3A-1T B	5V/12A	12-15V/3A	18 or 24V/2A
GOF3A-1T C	5V/12A	5V/6A	12-15V/3A
GOF3A-1T D	5V/12A	18 or 24V/2A	12-15V/3A

Dim: 4.30" x 16.75" x 4.88"
Weight: 16 lbs.

GSC power supplies sell faster than we can stock out shelves. Please plan ahead and allow 2-4 weeks for delivery.

PLEASE ORDER BY PART NUMBER

PRIORITY ONE ELECTRONICS

ISOBAR™

ISOLATED MULTIPLE OUTLET POWER STRIPS

With Built-In Noise Filters and Surge Suppressors

ELIMINATES INTERFERENCE FROM PHOTOCOPIERS, AND OTHER NOISE GENERATING OFFICE EQUIPMENT.

A MUST FOR EVERY OFFICE WITH DATA PROCESSING EQUIPMENT INCLUDING WORD PROCESSORS, MINI COMPUTERS, TYPEWRITERS, FACSIMILE APPARATUS, ETC.

ISOLATES SENSITIVE AND VALUABLE EQUIPMENT FROM: Equipment interaction — Damaging High Voltage Spikes — AC line noise and hash.

PROTECTS AGAINST: Voltage transients caused by lightning, contact switching, turn-off of inductive components, noise due to electromagnetic coupling.

USE THE GSC ISOBAR™ TO ISOLATE: Microprocessor from peripherals — Lab instruments from noisy equipment — Sensitive pre-amp or tape deck from power amplifier.

THE GSC ISOBAR™ ELIMINATES: Equipment interaction — Equipment damage from power line spikes and surges — Errors — False printouts — Disk Skips — Audio or video hash.

FEATURES: Inductive isolated grounds — Sockets individually filter isolated — Circuit breaker protected at 15A.

VOLTAGE TRANSIENT SPIKE PROTECTION: 2000 A peak for up to 6 μSec duration spikes. 1000A, 8/20 μSec protection from repeated spikes.

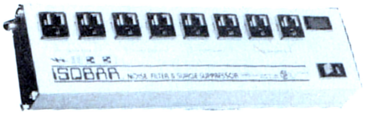
LOAD HANDLING: 1875 W max. total load; 15A per socket.

INPUT: 125 VAC, 15 amps; standard 3-prong plug.

IBAR 3

Three common outlets built-in circuit breaker, pilot light, hang-up bracket and a 6 foot cord.

		LIST PRICE	OUR PRICE
GOFIBAR3	SH. WT. 3 lbs.	$59.95	**$39.95**



IBAR46

Four independently isolated outlets. Built-in 15A circuit breaker, pilot light, switch, and 6 foot cord.

		LIST PRICE	OUR PRICE
GOFIBAR46	SH. WT. 4 lbs.	$79.95	**$49.95**

IBAR8-6

8 outlets, grouped to form 4 independently isolated sets of two. Built in 15A circuit breaker, on/off switch, pilot light.

		LIST PRICE	OUR PRICE
GOFIBAR86	SH. WT. 5 lbs.	$84.95	**$54.95**

IBAR9RM

Eight rear-mounted outlets grouped to form four independently isolated sets of two, plus one non-isolated convenience outlet on front face. 19" rack mount cabinet. Built in 15A circuit breaker, pilot light, on/off switch, and 6 foot cord.

		LIST PRICE	OUR PRICE
GOFIBAR9RM	SH. WT. 6 lbs.	$99.95	**$74.95**

7 OUTLETS WITH SWITCH & PILOT LIGHT

Anodized aluminum 1 outlet on front, 6 on back. Size: 19" W x 3½ H x 3⅛" D., SH. WT. 6 lbs.

GOF19RRPS7 - with 6 foot power cord. **$39.95**

POWERMATE
CORD REEL

6 OUTLET MULTI USE CORD REEL

THE CONVENIENCE OF AN EXTENSION CORD AND POWER DISTRIBUTION PANEL IN ONE COMPACT, SELF-STORING UNIT!

- Six grounded 3-prong outlets!
- 7 M (22 ft. or 50 ft.) 14 gauge, 3-conductor power cord - rated for indoor/outdoor use!
- Circuit breaker for safety's sake — Guards against overloads above 10 amps. Indestructible space-age plastic case designed for years of heavy use!

GOFCR21 22 Ft.	Sh. Wt. 5 lbs.	**$24.95**
GOFCR50 50 Ft.	Sh. Wt. 10 lbs.	**$49.95**

GSC POWERMATE

LINE STABILIZERS

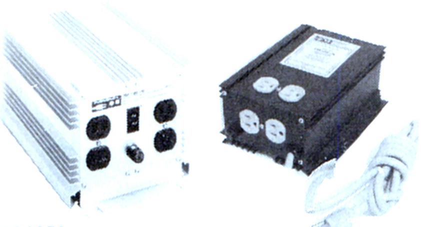
FULLY AUTOMATIC LINE REGULATION OVER AN 85V AC TO 125V AC INPUT RANGE. 15 AMP LOAD CAPACITY.

IDEAL FOR:

- Powering mini computer systems & computer peripherals.
- Operating sensitive test apparatus.
- Powering television sets.
- Wherever constant AC line power is required.
- Constant 115V AC output.
- 4% output regulation for all combined effects of line and load.
- 4 or 6 grounded 3 prong outlets.
- 6 ft. 14 gauge — 3 conductor power cord.
- Fully protected against overload.
- Rugged anodized aluminum case.
- Designed for direct wall or floor mounting, or bench top use.

TRA SERIES SPECIFICATIONS

AC OUTPUT; Line Regulation - ±4% over input range 90-120V AC for nominal115V AC OUT. **Load Regulation** - 2% for no load to full load. **Minimum Load** - Zero. **Temperature Coefficient** - 0.01%/°C. **Efficiency** - 98%. **Distortion** - Total harmonic distortion less than 0.1%. **Spikes** - No spikes on turn-on or turn-off. **High Line Regulation** - Above 120V AC Input - 1% per % line variation. **AC INPUT; Line** - 80-120V AC, 47-440Hz. **Efficiency** - 98%. **In Rush Current** - 1 Amp under no load. **Input Power Factor** - 0.985 (for TRA 1650); 0.970 (for TRA 1150); 0.960 (for TRA 650). **OVERSHOOT** - No overshoot on turn-on or turn-off. **RESPONSE TIME** - 1 cycle maximum. **OPERATING TEMPERATURE RANGE** - 0-60°C with no derating. **OVERLOAD PROTECTION** - Fused output.



TRA650
500WATTS, 4 RECEPTICLES

		LIST PIRCE	OUR PRICE
GOFTRA650	SH. WT. 10 lbs.	$79.95	**$69.95**

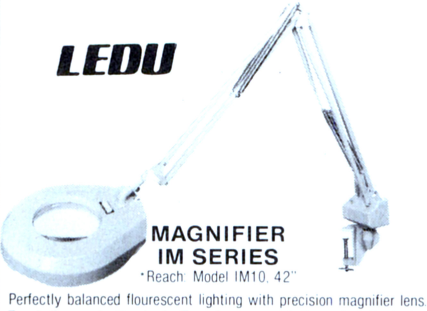
TRA1150
1000 WATTS 4 RECEPTICLES

		LIST PRICE	OUR PRICE
GOFTRA1150	SH. WT. 20 lbs.	$159.95	**$139.95**

TRA1650
1500 WATTS, 6 RECEPTICLES

		LIST PRICE	OUR PRICE
GOFTRA1650	SH. WT. 20 lbs.	$239.95	**$210.00**

LEDU



MAGNIFIER IM SERIES

*Reach: Model IM10, 42"

Perfectly balanced flourescent lighting with precision magnifier lens. Tough thermoplastic shade. Easy lens removal. New wire clip design permits easy installation and removal of fluorescent tube. Comes with plastic shield to protect tube from soiling and damage.

Colors: Gray, Black, White, Chocolate Brown. Comes with one 22 watt T-9 Circline fluorescent tube. 3 diopter lens standard. Shipping weight with bracket 8 lbs.

PART NO.	COLOR	LIST PRICE	OUR PRICE
LDUIM10AGY	Gray	$104.95	**$69.96**
LDUIM10ABK	Black	$104.95	**$69.96**
LDUIM10ACB	Choc. Brown	$104.95	**$69.96**
LDU5DLNS	5 Diopter Lens		**$16.00**

GSC

MULTIPLE OUTLET STRIPS

Designed with GSC's traditional regard for quality, safety and long life, Powermate Multiple Outlet Strips set a new standard of excellence. The unique two-piece extruded Aluminum Channel body is very strong and rigid for maximum wearability. All Powerstrip models are circuit-breaker protected, CSA and UL listed.

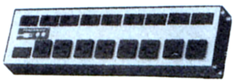
GENERAL SPECIFICATIONS:

Size: 2" W x 1¾" H. (Length according to Model).

Maximum Power Rating: 15A, 125 VAC, 60 Hz, 1875 Watts continuous duty. **Outlets:** 3-prong "U" ground. **Case:** Anodized extruded aluminum. **Protection:** Circuit Breaker. 6'line cord.

MODEL

MODEL	LENGTH	OUTLET	SW	LIGHT	PRICE
GOF9P56	9"	5	No	No	**$15.95**
GOF9PLS46	9"	4	Yes	Yes	**$16.95**
GOF12P76	12"	7	No	No	**$19.95**
GOF12PLS66	12"	6	Yes	Yes	**$22.95**
GOF24PLS86	24"	8	Yes	Yes	**$29.95**
GOF48PS86	48"	8	Yes	No	**$39.95**
GOF72PS86	72"	8	Yes	No	**$47.50**



MODEL	LENGTH	OUTLET	SW	LIGHT	PRICE
GOF9LSC46	9"x3.5"	4	5	5	**$28.95**
GOF12PLSC86	12x3.5"	8	9	9	**$41.95**

Vista

VISTA DATASAVER

AC POWER BACK-UP UNIT

DATASAVER AC POWER BACK-UP PRODUCTS: The 90 Watt Datasaver is a battery-powered, AC power back-up unit which keeps micro-computer systems, instruments, and emergency equipment operating during AC line power interruptions or transients. In addition to normal back-up use, Datasaver can make AC-powered systems completely portable for mobile or remote site applications through provisions for plugging in an suxiliary 12 Volt battery source.

Datasaver provides continuouslt filtered AC power from a pair of U.S. standard (NEMA 5-15R) output receptacles located on the rear panel. AC power back-up time provided by the internal battery is from two to five minutes at 90 Watts full power, to typically 15 minutes at half-rated power.

Housed in a compact metal enclosure just one-eighth of a cubic foot in volume, the Datasaver unit contains a rechargeable sealed battery, automatic battery charger, solid-state power inverter, AC line voltage monitor and cutout switch, front-panel power status indicator (a green/red LED), and an alarm buzzer (with a rear-panel silencing switch) to warn the user of the loss of AC line power. An internally generated Remote Alarm signal is available to drive an external opto-coupler to indicate loss of AC line power in interrupt-driven computer system applications.

The status indicator light is green when adequate AC line voltage is applied. Upon loss of line power, the indicator changes to red and briefly goes off each five seconds to indicate that the internal battery can supply back-up AC power for up to five minutes or more, or off each second to warn when only two minutes or more of back-up power remains.

FEATURES & SPECIFICATIONS:

DATASAVER	MODEL 90 120 60
OUTPUT POWER (single phase, case grounded)	90 Watts (VA) max
OUTPUT VOLTAGE (sine or equivalent retangular waveform)	120 VAC (100-132 VRMS)
OUTPUT FREQUENCY (AC line or crystal controlled)	60 Hertz ±0.1%
AC LINE INPUT POWER	120 VAC at 1.5A
LOW-LINE TRANSFER VOLTAGE (from line to back-up)	100-103 VAC
TRANSFER TIME	10 msec
AUXILIARY BATTERY SOURCE	12 VDC (11-14.4 VDC with own charger)
DATASAVER SIZE AND WEIGHT (U.S./Metric)	4 in./10.2 cm. HIGH, 6 in./15.2 cm. WIDE, 9 in./22.9 cm. LONG. 10 pounds/4.5 kg.

PART NO.	OUTPUT	LIST PRICE	OUR PRICE
VIS9012060	120VAC 60Hz	$395.00	**$375.00**
VIS9022050	220 VAC 50 Hz	$450.00	**$435.00**

WE ACCEPT VISA, and MASTER CARD

NEDA

VISA

MEMBER MTA

master charge THE INTERBANK CARD

PRIORITY 1 ELECTRONICS

ORDERING INFORMATION

- **BY PHONE: (800) 423-5922, (213) 709-5464**
- **BY MAIL: 9161C Deering Ave., Chatsworth, CA 91311**

MINIMUM ORDER

$15.00 IN MERCHANDISE on prepaid U.S. orders. Payment may be made by **check, money order, Mastercard, VISA,** and by bank transfer. (Call for details.)

OPEN ACCOUNTS

U.S. only. **$30.00 MINIMUM.** We gladly accept purchase orders from government, schools, and firms with **a published A1 rating from Dunn & Bradstreet.** All orders are FOB Chatsworth, California. UPS Freight Charges will be prepaid and added to the invoice. All other shipments are collect. Payment must be made within thirty days of shipment from our standard commercial invoice. Customer supplied voucher forms can not be completed. Orders that require completion of such forms will be returned unprocessed. There will be a $10.00 service charge for any unearned discounts taken. Customer agrees to pay all finance, late, and collection charges on past due accounts. By placing an order with ***PRIORITY 1 ELECTRONICS*** customer agrees that the "***PRIORITY 1 ELECTRONICS*** Conditions of Sale" shall be the sole and governing terms of any purchase order or contract. An applications for credit is available upon request. Please include payment with your initial order: credit applications take four to six weeks to process.

C.O.D

We do not accept C.O.D. orders.

SALES TAX

Add 6% sales tax to all parts delivered in California. If the merchandise is for resale, you must include a signed standard resale permit card (not just a tax number) to qualify for exemption.

PHONE NUMBERS

ORDER DESK: To place an order from outside CA, AK, HI. Call:

(800) 423-5922

SALES DEPT: To place an order, inquire about product availability or to make a technical inquiry call:

(213) 709-5464

CUSTOMER SERVICE: To inquire about an order, your account or a missing or damaged package, call Monday thru Friday, 9 a.m. to 4 p.m.

(213) 709-5393

LARGE QUANTITY QUOTATION OR BIDS

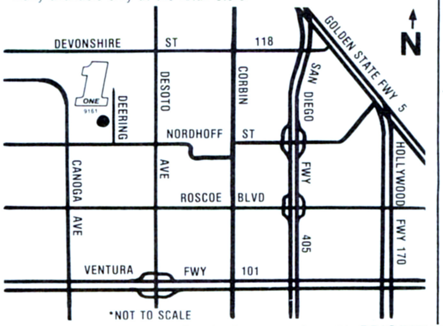
PRIORITY 1 ELECTRONICS will quote on quantities in excess of the maximum amounts shown in the selection guide.

PRICES

Prices are net. FOB Chatsworth, California. Prices are subject to change without notice. Due to the wide fluctuations in the price of precious metals, we reserve the right to revise prices at the time of shipment, without notice, on items that contain gold or silver such as ICs, connectors, and wire. For u p to the minute prices and for prices in excess of those shown. Call ***PRIORITY 1 ELECTRONICS***, (213) 709-5464, (800) 423-5922.

RETAIL STORE

Visit our retail showroom anytime Monday-Friday 9-6, Saturday 10-5. You can pick-up your parts and brouse through thousands of items, many available only at the retail store.



U.S. SHIPPING AND HANDLING

SAVE ENERGY
SHOP BY MAIL

All orders under 50 lbs. are shipped via UPS insured unless otherwise specified. For orders shipped via mail (not recommended) all packages to the U.S., its possessions and territories and Canada, are insured to a maximum of $200.00. **Minimum mail shipping and handling charge is $3.50. Orders over 50 lbs. will be shipped via motor freight collect.** The weights listed in the product descriptions are approximate figures. To compute your shipping and handling charge, consult the table below.

UPS SHIPPING CHARGES

UP TO	GROUND*	AIR**	UP TO	GROUND*	AIR**
1 lb.	$ 2.50	$ 3.00	26 lbs.	$12.29	$34.31
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4 lbs.	$ 2.94	$ 6.63	29 lbs.	$13.97	$38.07
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14 lbs.	$ 7.19	$19.22	39 lbs.	$17.82	$50.66
15 lbs.	$ 7.62	$20.47	40 lbs.	$18.24	$51.93
16 lbs.	$ 8.05	$21.73	41 lbs.	$18.67	$53.19
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18 lbs.	$ 8.89	$24.25	43 lbs.	$19.52	$55.71
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20 lbs.	$ 9.75	$26.76	45 lbs.	$20.37	$58.22
21 lbs.	$10.17	$28.03	46 lbs.	$20.79	$59.47
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	QTY. ORDERED			PART NUMBER	DESCRIPTION	WEIGHT	UNIT PRICE	AMOUNT
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
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12.								
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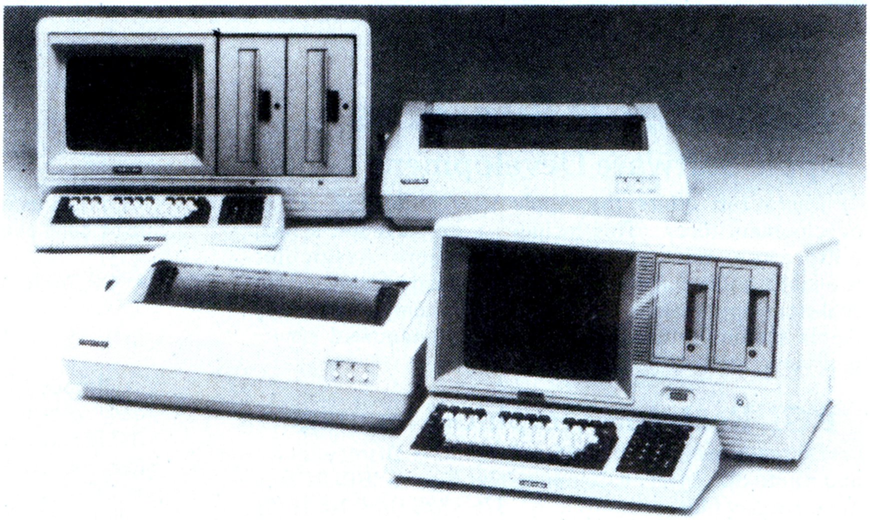

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Total user customizability is a predominate reason that over a thousand users find VEDIT the easiest to use full screen editor. It makes VEDIT the only editing package which allows you to determine your own keyboard layout and use the cursor and special function keys on any terminal having them. And only VEDIT fully supports all of the newly available terminals. It may come as a surprise to you, that with any other editor or word processor, you will have to memorize obscure control characters or multi-character sequences, while your terminal's extra keys and editing functions go unused. The customization extends to setting the default tab positions, scrolling methods and much more. It's almost like designing your own editor for your system, applications and preferences. And all of this is easily done with the setup program which requires no programming knowledge or 'patches', but simply prompts you to press a key or enter a parameter.

Unequaled Hardware Support

The CRT version supports all terminals by allowing you to select during setup which terminal VEDIT will run on. Features such as line insert and delete, reverse scroll, status line and reverse video are used on 'smart' terminals. All screen sizes are supported, including large ones such as the 60 X 80 format on the Ann Arbor Ambassador terminal. Special function keys on terminals such as the Heath H19, Televideo 920C and IBM 3101, and keyboards producing 8 bit codes are all supported. The memory mapped version is extremely flexible and supports bank select and hardware cursors such as on the SSM VB3. With this level of customizability and hardware support, you will feel for the first time that the software was optimally designed for your system.

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Since VEDIT creates and edits standard text files of up to one diskette in length, it serves as a replacement for the CP/M standard editor ED. Of course, you benefit from the fastest and easiest to use 'What you see is what you get' type full screen editing available, fast disk access and an editor which takes up only 12K of your valuable memory space. With VEDIT you will never again need or want to use the slow and tedious ED.

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VEDIT is more than just a full screen editing replacement for ED, it gives you many new editing capabilities, such as a scratchpad buffer for moving and rearranging sections of text, complete file handling on multiple drives and iteration macros. Amoung its special features you will find automatic indenting for use with structured programming languages such as Pascal and PL/I, and other special facilities for Assembler and COBOL. A real time saver is the ability to insert a specified line range of another file anywhere in the text. Unlike most software, VEDIT will even tolerate your mistakes. For example, one key will 'Undo' the changes you mistakenly made to a screen line, and the disk write error recovery lets you delete files or insert another disk should you run out of disk space.

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a suitable piece of aluminum rod over fine emery paper will quickly achieve the required height.

Before seating the sensor at this distance with a small drop of epoxy, the small indexing tab above pin 8 must be removed so that the tip assembly can be threaded into the barrel. Careful filing does the trick. The leads should also be trimmed to guard against electrical shorting after assembly.

At this point, all that remains is to solder the cable leads and complete final assembly. In addition to soldering the cable connections on the sensor, solder a wire between pins 4 and 8 and extend it another 10 cm (4 inches). This is the ground lead for the side-mounted LED. Carefully screw the tip assembly into the barrel while rotating the cable with the tip assembly. This is easier to accomplish with two people: one holds the cable and tip assembly, the other turns the barrel.

Fish the indicator LED's ground and cable lines through the side hole and half-grommet and solder them to the LED's shortened leads. Place a small drop of epoxy on the LED and half-grommet and press them into the side hole from the outside. The scanning wand is now complete. The finished product, with calibration cylinder, appears in photo 1.

Sensing Circuit

As shown in figure 3, the circuitry to make the sensor's output TTL- (transistor transistor-logic) compatible requires only two integrated circuits. Three op amps in the LM324 packages handle amplification and comparative functions, while the 7413 NAND Schmitt trigger "cleans up" the sensor's output by only passing pulses above a threshold voltage. To stabilize the common-collector circuit using the sensor's NPN transistor, a 15 pF capacitor and 1 megohm resistor are put in parallel with the transistor. Nominal outputs at this stage are approximately +3.2 V for a light-absorbing surface (black) and +1.7 V for a reflecting surface (white). These values can be adjusted by varying resistor R10.

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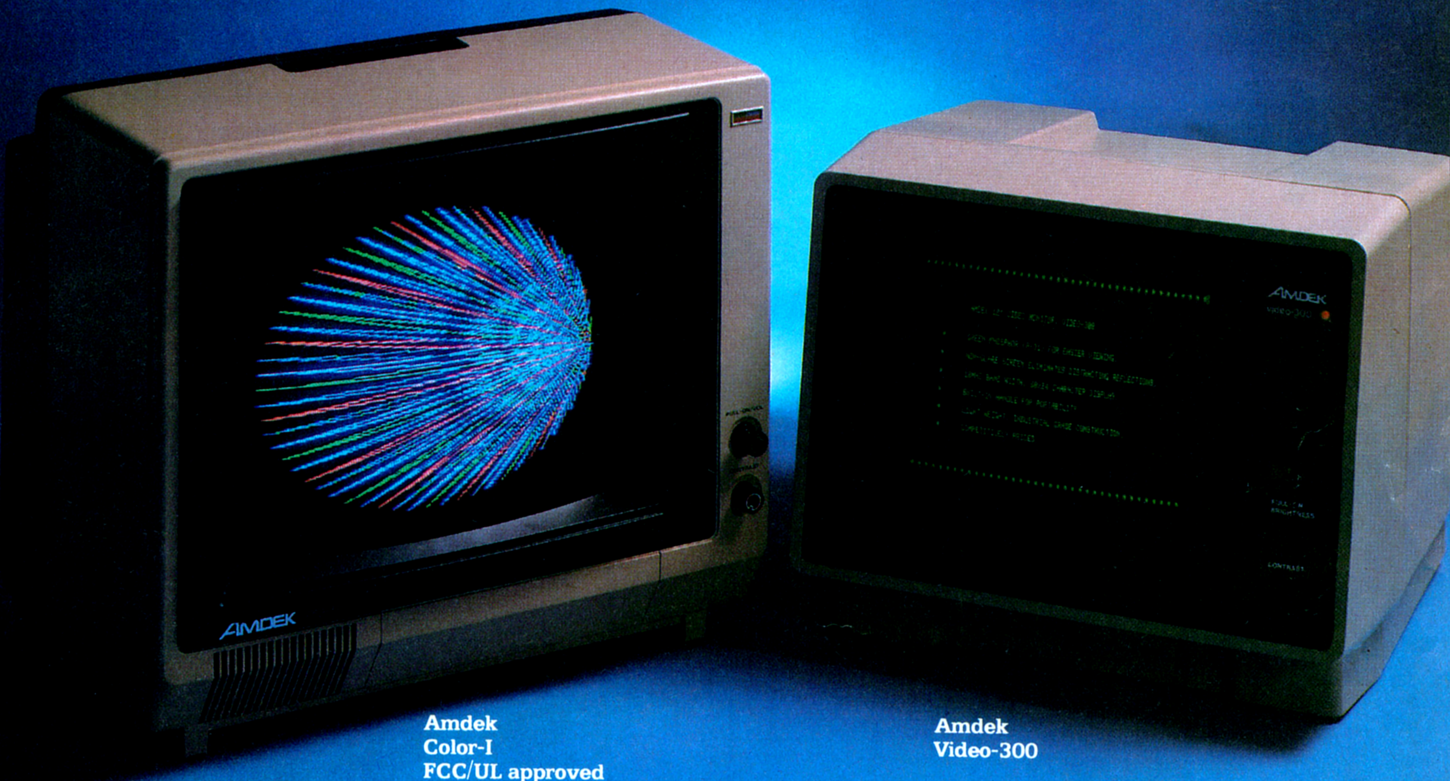

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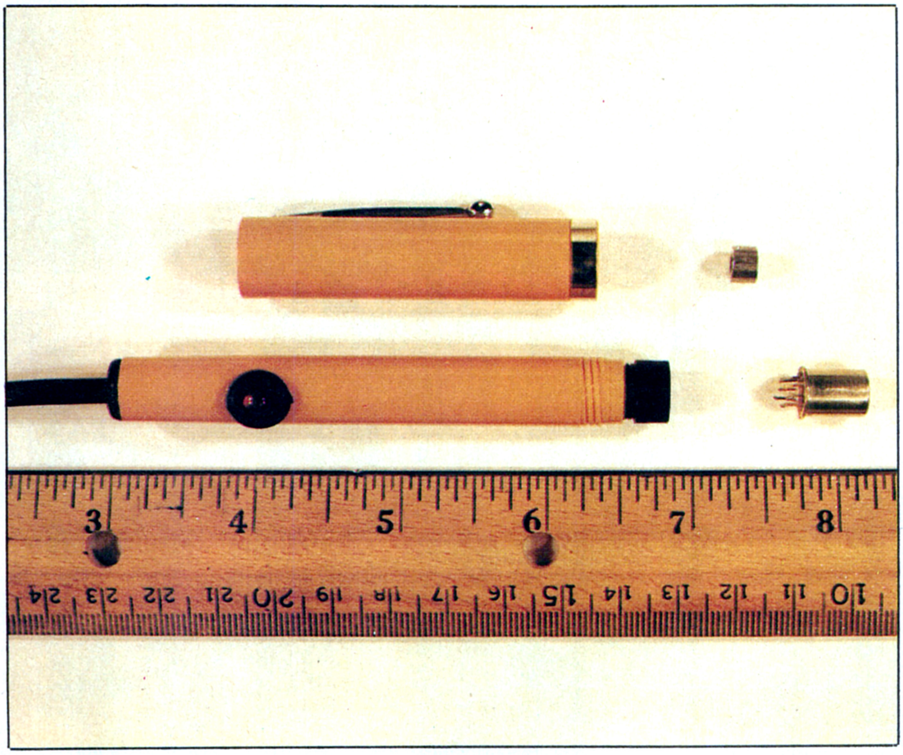

Photo 1: *Author's bar-code scanning wand. The wand is based on Hewlett-Packard's HEDS-1000 optical reflective sensor (the metal can with eight pins), and a Schaefer No Nonsense ball-point pen. The calibration cylinder appears at the right of the HEDS-1000 module.*

The signal is fed to the inverting input of one of the LM324's op amps, which is configured as a comparator. The amplifier's other input receives a reference voltage set through the voltage divider of R3 and R4. The divider network should be adjusted so that this input to the amplifier is about +2.5 V, which will ensure that the scanner produces on and off pulses approximately equal in length (while scanning equally sized absorbing and reflecting characters).

The output of the first op-amp stage is coupled to the inverting input of the second op-amp comparator, which drives the scanner's LED. The first stage's output is also sent to a voltage follower that drives a NAND Schmitt trigger. Besides functioning as an inverter, the Schmitt trigger provides a sharp output that is filtered by the 1000 pF capacitor. Although the addition of this capacitor does cut down on response time when scanning at extremely high rates, it poses no problem for practical hand scanning.

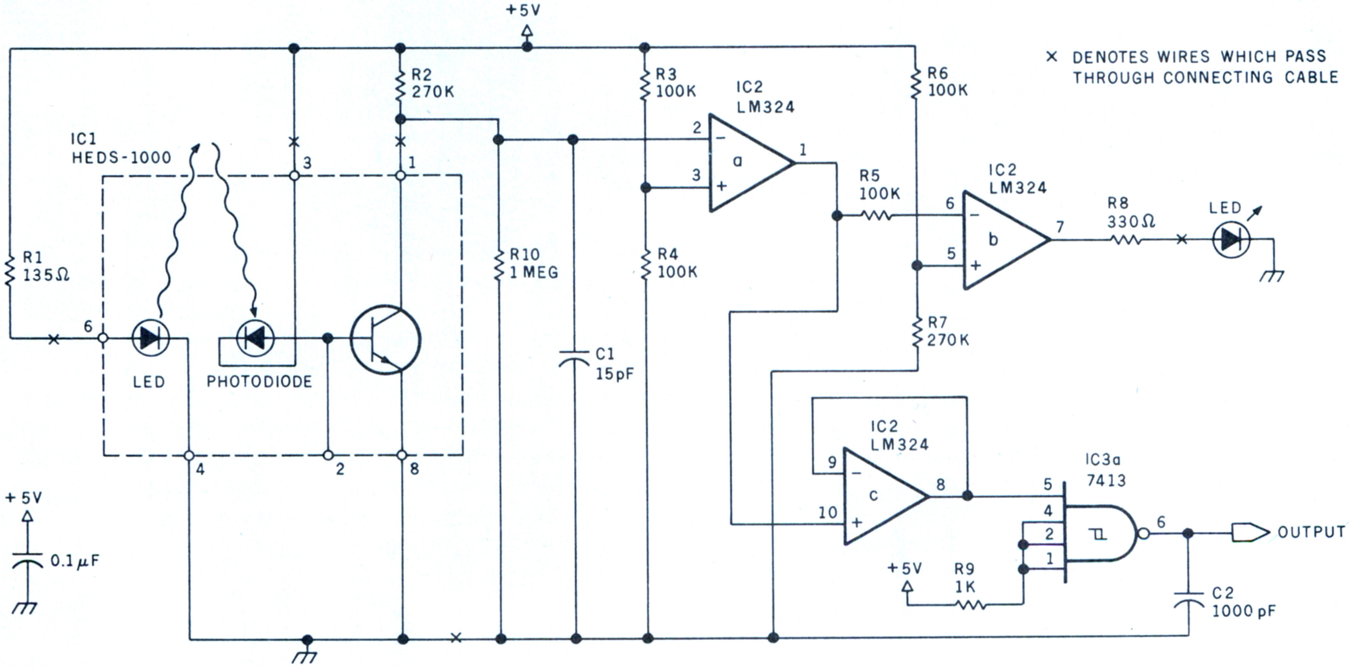
+5V
× DENOTES WIRES WHICH PASS THROUGH CONNECTING CABLE
R2 270K
R3 100K
IC2 LM324
R6 100K
IC1 HEDS-1000
R1 135Ω
LED
PHOTODIODE
R10 1 MEG
C1 15pF
R4 100K
R5 100K
R7 270K
R8 330Ω
LED
IC2 LM324
IC3a 7413
+5V
R9 1K
C2 1000 pF
OUTPUT
+5V
0.1μF
a
b
c
1
2
3
4
5
6
7
8
9
10

Figure 3: *Schematic diagram of the circuit to make the sensor's output compatible with transistor-transistor logic. The sensor's integral NPN transistor is connected as an amplifier/driver. One section of an LM324 quad-operational amplifier is connected as an inverting comparator. The output of this stage is fed to the indicator LED (mounted on the pen barrel) through a second amplifier section. The signal also goes to a voltage-follower-connected op amp that drives a Schmitt-trigger NAND gate. The NAND gate's sharp output pulse is filtered with a 1000 pF capacitor.*

Number	Type	+5 V	GND
IC1	HEDS1000		
IC2	LM324	4	11
IC3	7413	14	7

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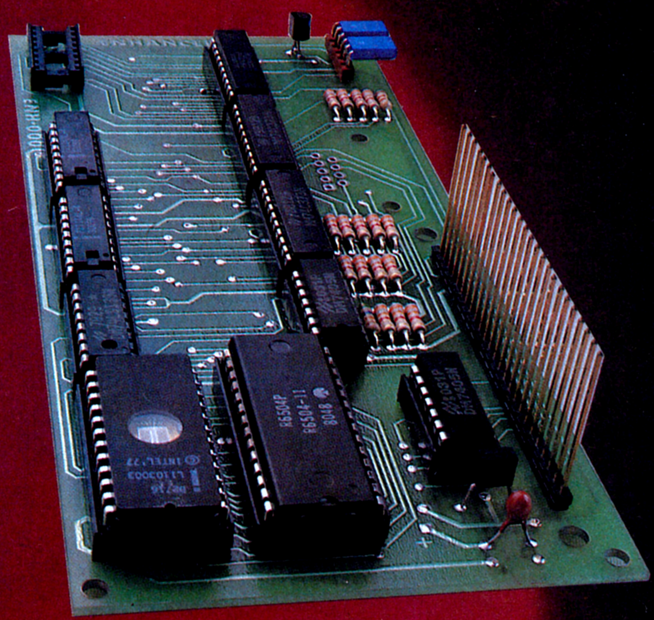

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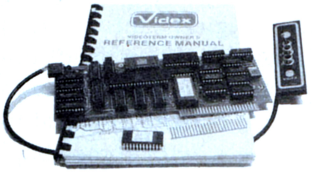

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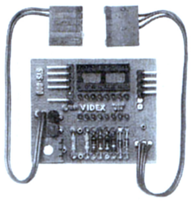
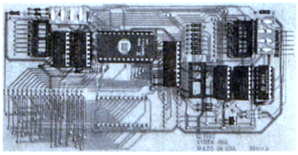
■ SOFT VIDEO SWITCH



The Soft Video Switch is an automatic version of the popular Switchplate. It knows whether it should display 40 or 80 columns or Apple graphics. It does the tedious work of switching video-out signals so you don't have to. The Soft Video Switch can be controlled by software. Any Videoterm with Firmware 2.0 or greater may be used with the Soft Video Switch. The single wire shift mod is also supported. Package price is $35.00.

■ KEYBOARD AND DISPLAY ENHANCER



The original Keyboard and Display Enhancer is still available for Revision 0-6 Apples (on which the new Enhancer][will not fit). These Apples have memory select sockets at chip locations D1, E1 & F1. The Keyboard and Display Enhancer allows entry and display of upper & lower case letters with fully functional shift keys. It does NOT have user definable keys nor a type ahead buffer. The price is $129.00.

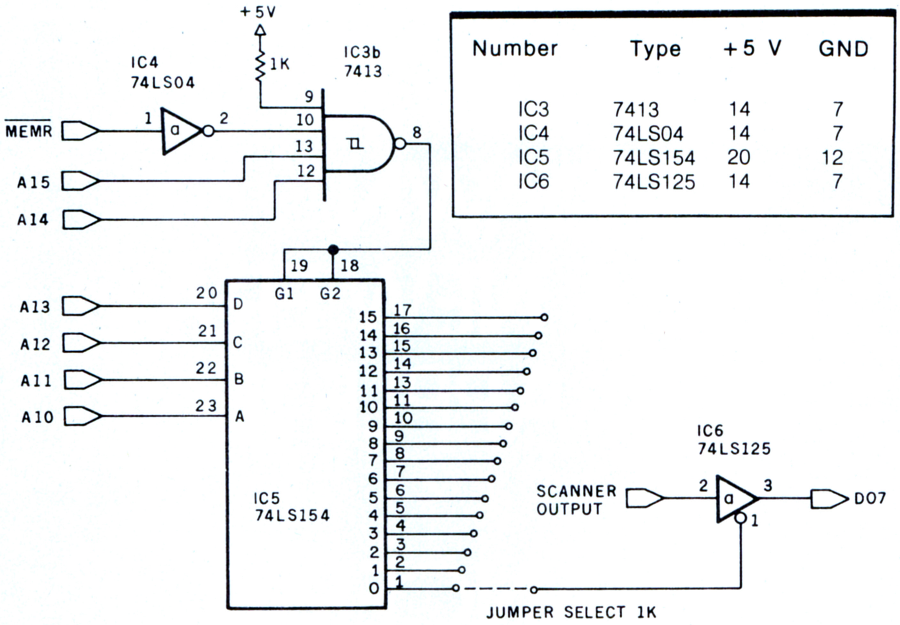
■ ACCESSORIES:

Videoterm Utilities Disc (includes) $37.00
- Font Editor
- Pascal Mid-Res Graphics
- Applesoft Read Screen Utility
- Top & Bottom Scrolling
- Pascal Vidpatch
- Graphics Template

Character Set EPROMs $29.00 ea
- Half Intensity
- Inverse
- German
- Katakana (Japanese)
- Line Drawing Graphics (Expanded)
- Spanish
- French
- Math & Greek Symbols
- Super & Subscript

Dvorak EPROM (Enhancer) $29.00

Lower Case Chip $29.00



Number	Type	+5 V	GND
IC3	7413	14	7
IC4	74LS04	14	7
IC5	74LS154	20	12
IC6	74LS125	14	7

Figure 4: *Memory-mapped interface to the signal bus of a microcomputer. The decoding circuitry will gate the bar-code scanner's output onto the data bus whenever an address within the selected 1 K-byte space is accessed by a memory-reference instruction. In this arrangement, the 1 K-byte space resides somewhere in the top 16 K bytes of the address space. (This interface is compatible with the software presented in Ken Budnick's book* Bar Code Loader.*)*

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- DUAL USE. A PRINTER AND A TYPEWRITER
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The BYTEWRITER is a printer consisting of a micro-processor controlled assembly internally connected to an SCM Coronamatic 8000 office typewriter.

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That's all there is to making a simple bar-code scanner. The circuit in figure 4 illustrates an extremely simple interface to an 8-bit microcomputer bus. The signal from the wand's output is gated onto the computer's data bus through a memory-mapped addressing scheme. The wand's output will be available when a memory-reference instruction is executed addressing a 1 K-byte block anywhere in the top 16 K bytes of address space (the specific block is selected by a jumper connection). The high-order bit on the data bus receives the signal.

Ken Budnick's book *Bar Code Loader* (available from BYTE Books) contains bar-decoding programs for the 8080, 6800, and 6502 microprocessors which read the high-order data bit. Due to their simplicity, the routines can be easily modified to work in almost any system.

One comment should be made concerning this software. Even on my slow 2.048 MHz 8080A-based system, I found it was impossible to scan fast enough to keep the counting register from timing out (the register exceeded the counting limit of 255). By adding a DCR...JNZ (decrement register...jump on not zero) loop in the input scanner sections of the software, I solved the problem. I suspect that similar changes will have to be made to the software for other systems. Note that the addition of this time-killing loop does not result in a significant reduction in practical hand-held scanning speeds—I accurately and reproducibly scan at more than 25 cm (10 inches) per second.

Bar codes represent a reliable and convenient method of mass-distributing digital information. Hewlett-Packard's design and production of the HEDS-1000 sensor makes bar-code reading practical for me. Combining it with some simple interfacing has made printed software a reality. ■

The HEDS-1000 optical-reflective sensor can be ordered from Hamilton-Avnet, 1175 Bordeaux Dr, Sunnyvale CA 94086. Address orders to Sales Department.

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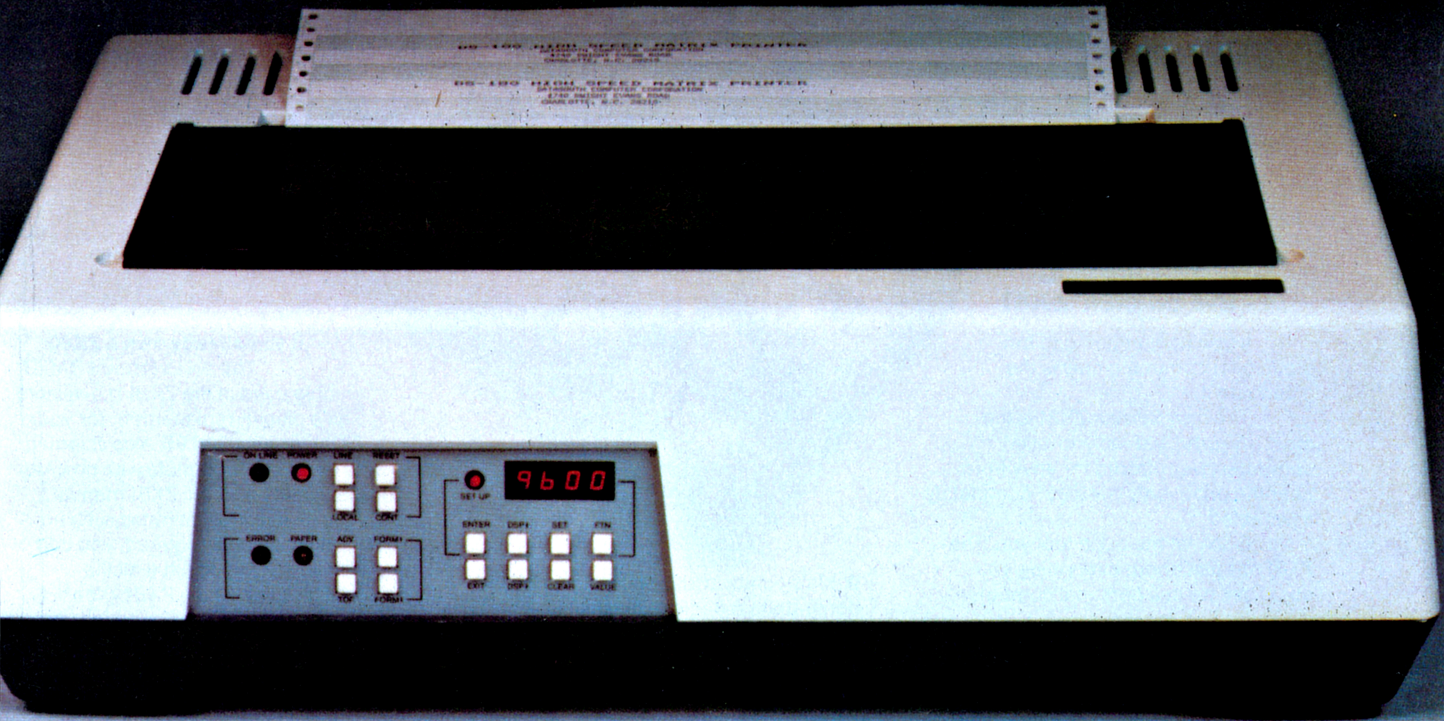

With so many matrix printers on the market today, it may seem tough to find exactly the right one for your application. Some models may offer the speed you need, others the communications flexibility and still others the forms handling capability. But no printer offers **all** the features you need... until now.

The DS180 matrix printer provides the total package of performance features and reliability required for applications such as CRT slave copy, remote terminal networks and small to mid-range systems. Not a "hobby-grade" printer, the DS180 is a real workhorse designed to handle your most demanding printer requirements. And pricing on the DS180 is hundreds of dollars below competitive units.

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Communications Versatility—The DS180 offers three interfaces including RS232, current loop and 8-bit parallel. Baud rates from 110-9600 may be selected. A 1K buffer and X-on, X-off handshaking ensure optimum throughput.

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If you would like more information on how the DS180's low-cost total printer package can fill your application, give us a call at Datasouth. The DS180 is available for 30-day delivery from our sales/service distributors throughout the U.S.

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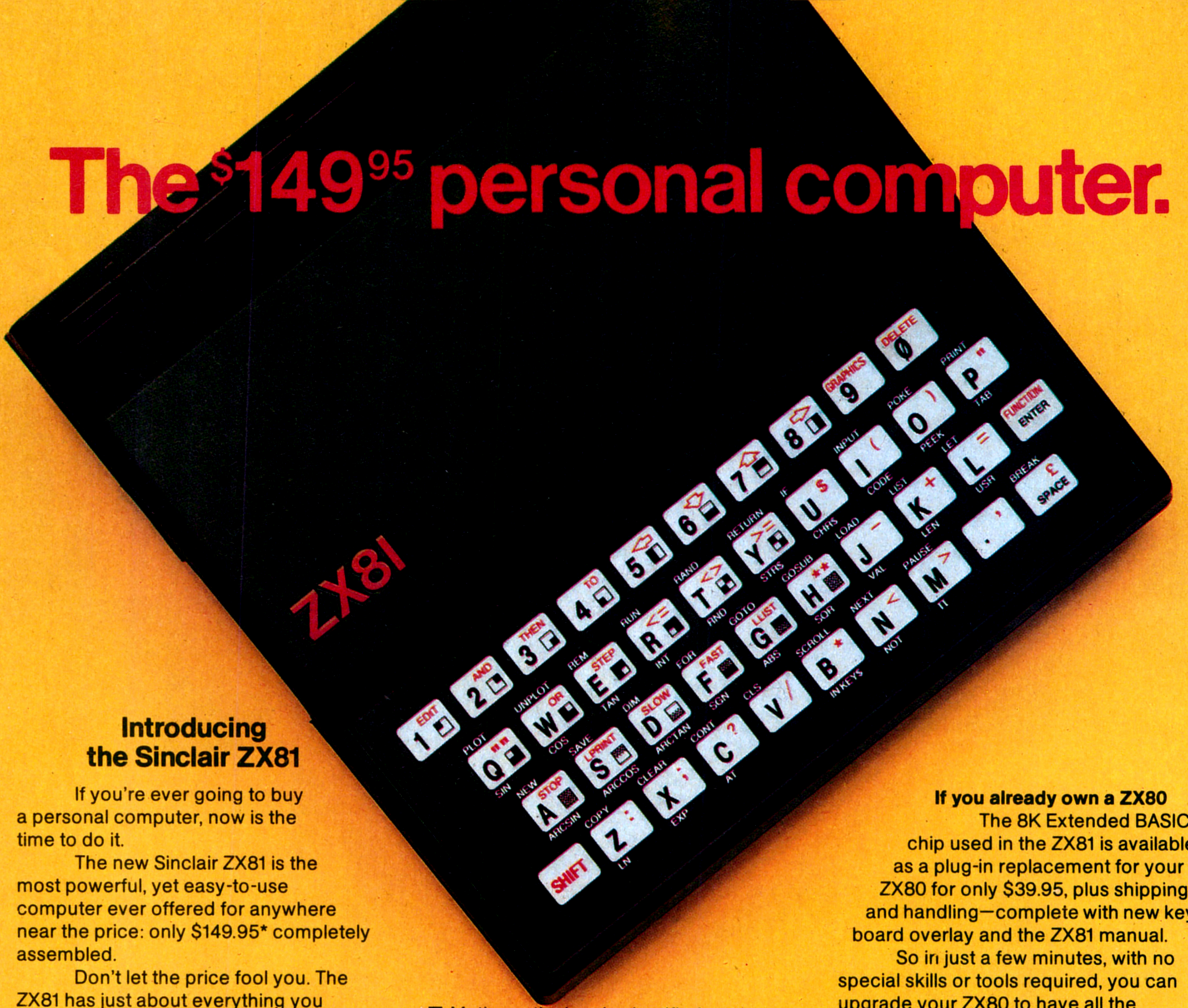
The $149⁹⁵ personal computer.



Introducing the Sinclair ZX81

If you're ever going to buy a personal computer, now is the time to do it.

The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only $149.95* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

A breakthrough in personal computers

The ZX81 is a major advance over the original Sinclair ZX80—the world's largest selling personal computer and the first for under $200.

In fact, the ZX81's new 8K Extended BASIC offers features found only on computers costing two or three times as much.

Just look at what you get:

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The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

If you already own a ZX80

The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

With the 8K BASIC chip, your ZX80 will also be equipped to use the ZX Printer and Sinclair software.

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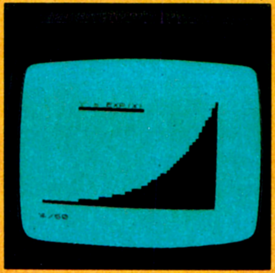
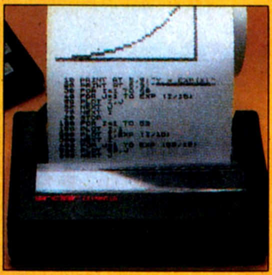
The Sinclair ZX81 is covered by a 10-day money-back guarantee and a limited 90-day warranty that includes free parts and labor through our national service-by-mail facilities.

*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.

**Does not apply to ZX81 kits.



NEW SOFTWARE: Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly coming out with new programs, so we'll send you our latest software catalog with your computer.



ZX PRINTER: The Sinclair ZX Printer will work with your ZX81, or ZX80 with 8K BASIC. It will be available in the near future and will cost less than $100.

16K MEMORY MODULE: Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC). Cost is $99.95, plus shipping and handling.

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The $\$99^{95}$ personal computer.

ZX81
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If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just $99.95.* It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

How to order

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Reversal

Othello for the Apple II

Mark Friedman
23 Forge Dr
Nashua NH 03060

"Winner of the software division of the First International Man-Machine Othello Tournament" is the declaration that catches your eye when you pick up the box. And if that's not intimidating enough to a casual game player, consider that Reversal is written by the Spracklens of Sargon chess fame. Is there any hope of winning? The answer is a most emphatic yes, depending on the level of play you select. At the same time, however, Reversal is capable of giving even the best player a tough run for the money.

The game is played on an eight-by-eight square board, and the object is to occupy more squares than your opponent. The game's rules are very simple: you place one piece on the board per turn and try to trap your opponent's pieces between your own; all pieces trapped become yours. It sounds simple, and, as any Othello player knows, it is . . . sometimes.

Reversal comes in the now standard Hayden Gameware box, with a better-than-average instruction booklet and a registration card. The disk carries what seems to be its own operating system, as well as the game itself, and is, of course, both write-protected and "uncopyable." At least the few casual efforts I made to copy it failed. The registration card indicates that if your original disk becomes unusable in less than a year, it will be replaced free of charge. The instruction booklet, however, states that replacement will be free for 90 days, after which a copy will cost $5.

Loading Reversal is simple, although a mention of its 13-sector status would make the first time even easier for those with systems that default to a 16-sector format. It might also make you feel a little better if you were warned that several head initializations, with their usual clatter, are normal (at least they were on my system, with any drive I used). Once loaded, you are offered four choices: play a game against your Apple II; start a game with any given board layout; play against a fellow human; or exit from the program. Be forewarned that exiting delivers you into the hands of the Monitor program. You should also be aware that the instruction booklet is written in a tutorial style, which is fine for a first reading, but a table of available commands would make life easier a week later.

If you elect to play a game, you are asked several ques-

At a Glance

Name
Reversal

Type
High-resolution graphics game playing a version of Othello

Manufacturer
Hayden Book Company
50 Essex St
Rochelle Park NJ 07662
(800) 821-3777

Price
$29.95 tape; $34.95 disk

Format
Apple cassette or 5-inch Apple floppy disk

Language
Assembler

Computer
Apple II with at least 32K bytes of memory; tape or disk drive; video monitor or TV

Documentation
14-page booklet

Audience
Game enthusiasts of all ages, Othello enthusiasts in particular

---

Othello is a trademark of CBS.

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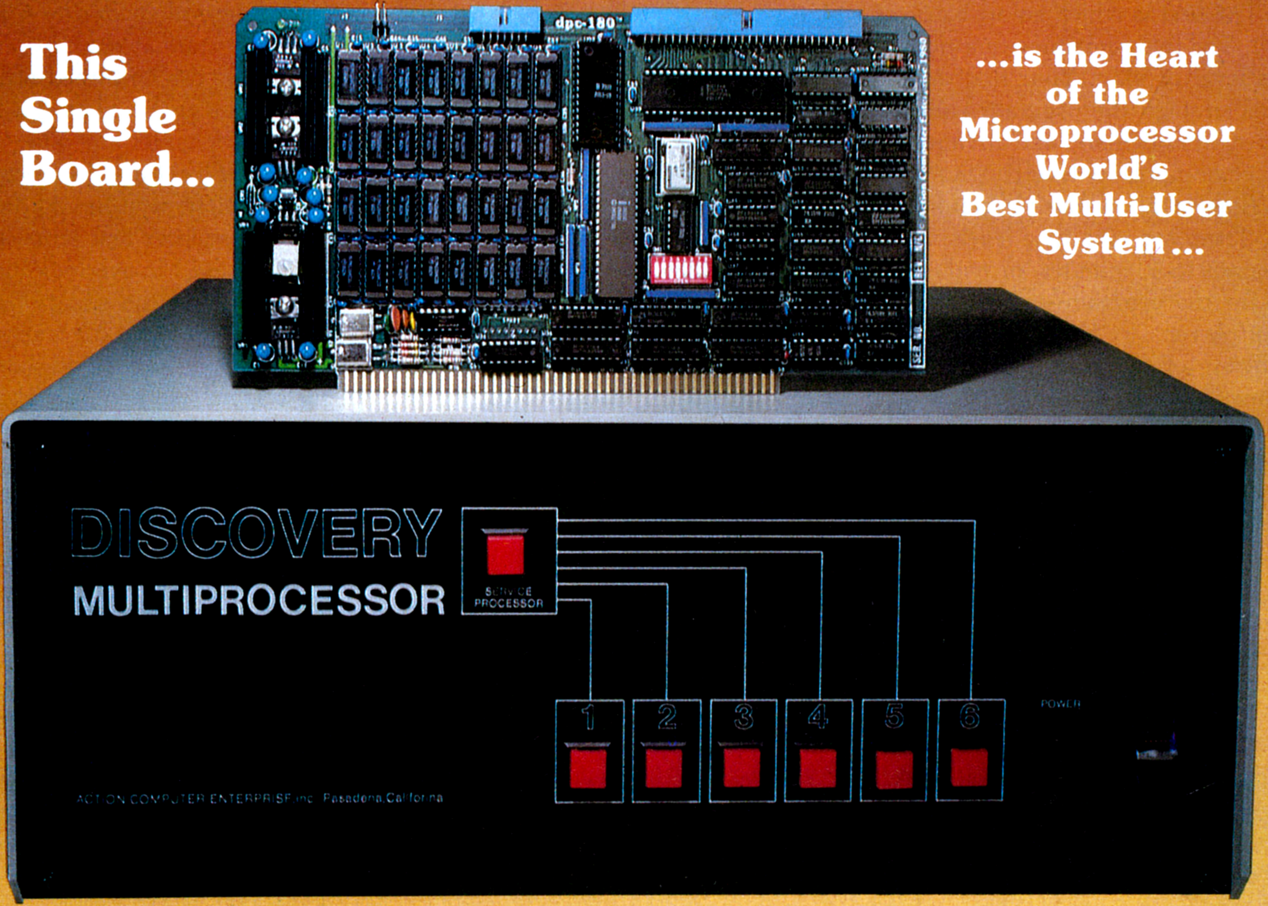

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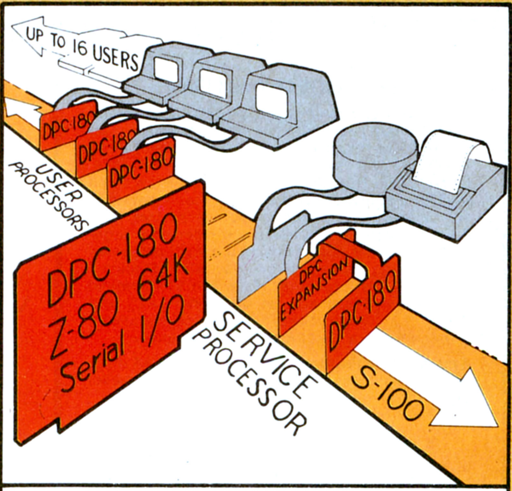

The ACE **DISCOVERY MULTIPROCESSOR** dedicates a complete 64K Z-80 Distributed Processing single board Computer, the **dpc-180**™ to each user. An expanded DPC coordinates all of the system activities.

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The Multiprocessing Company

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tions. The first is which color, black or white, you wish to play. The two remaining questions determine the program's level of play. Your first decision is to select the level of strategy the program will use, with choices of beginner, intermediate, and advanced (advanced is billed as its championship level). Your last decision is how much time to allow the program to determine its next move. There are nine time levels, listed as ranging from 2.5 seconds to 30 minutes, providing a total of 27 playing levels for the program—more than enough to suit any level of player.

Be aware of two things while selecting the program's play level. The first is that the printed list of "approximate" response times is *very* approximate. Level 6, with a listed time of one minute, varied from just under a minute to almost three minutes during one game played at the advanced strategy level. The second detail is that while the strategy level you pick cannot change during a game, the response-time level can be changed at any time, making play even more flexible.

Reversal makes use of both the text and graphics displays during execution, showing the level of play and move list on the text page and the board itself on the graphics page. Toggling between the two displays is done with the ESC (escape) key, although once a game has started, I've found little need for the text display other than to record a game for posterity. Reversal makes good use of the Apple's graphics, with a couple of nice touches like pieces that smile or frown depending on the score (when both sides are tied, they just stare at you). Should you find them distracting, the faces can be turned off.

Once you are looking at the game board, playing is as simple as it can be—at least the mechanics are. There is no need to memorize a list of board locations, as navigation is done with the cursor-control arrows. In addition, since the cursor will stop only on squares that represent legal moves, there is really no excuse for overlooking a possible move. Once you have found the square you would like to move to, just press Return. All trapped pieces will be flipped automatically, and the score, displayed on the sides of the screen, will be updated, as will the move list displayed on the text page. The program then begins its search for a suitable response.

Reversal is so easy to play that my five-year-old daughter was able to play her first game after five minutes of coaching. While her first game was a bit of a rout, she insisted on playing until she won, several times.

I tend to be a casual, rather than an aggressive, player, and my selection of playing levels reflected that. I got the most pleasure playing at the lower, faster-response levels, with a few highest-level (30-minute response) games thrown in for good measure. To compare the strategy levels, I played a series of games at each level. While I was able to win the majority of games at the beginner level, and half or more at intermediate, the advanced level was easily my match. In fact, one game played at

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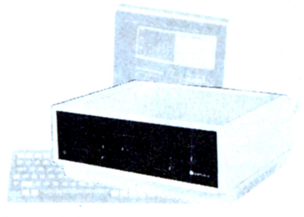
System I specifications: Z80A, 64K Ram, 4K diagnostic Eprom, two 5" 360K drives, serial and parallel port.



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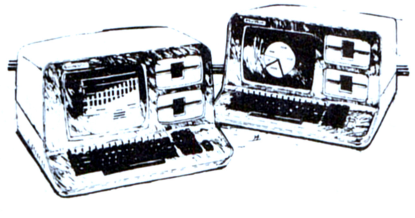
See Televideo System Ad.



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The Northstar Advantage Computer is an integrated package including full graphics capability. Line charts, bar graphs, pie charts and 3 dimensional displays are all possible as part of Northstar's optional graphics/DOS operating system or CP/M® graphics package. All Northstar applications software is available for the Advantage Computer. Slots for 6 additional expansion cards are included.

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level A6 was the most elegant example of trap-setting I have seen in a long time. Any time I can be beaten in the last five moves as badly as 63 to 1, I know I've met my match. That game made me wish there was a command to print the entire move list, rather than having to copy it by hand during the game—the game was over before I realized it was worth saving.

The program has two additional features that can make for a more varied game: the ability to take back any move and a way to ask what the program thinks your best move is. It can sometimes take an extreme effort of will not to back a game up to where you made some "mistake," but it can be fun to check out other possibilities, and it's nice to know you can. The ability to ask the program about your best move is also a nice idea, but because it is limited by the amount of look-ahead the program did in computing its move, it is, more often than not, not your best possible response.

As there is no way to save a game in progress, the only way to resume an interrupted game is to record the positions of all pieces and use the facility to start a game from a given board layout, but this is a tedious process. A "Save Game" command would have solved the problem, particularly when playing at levels requiring 30 minutes per response.

As long as I'm "wishing," there are a few other things that either should be included or would be handy to have. These include the ability to change strategy level during a game, having the "Exit" command reload the system, and a table of commands in the instruction booklet. In passing, let me recommend the user's guide section entitled "Strategy Tips" to anyone who plays Reversal. The tips may be obvious, but they're valuable nonetheless.

I highly recommend Reversal to anyone who enjoys Othello or to anyone who likes strategy games in general. Reversal can also serve as a good introductory computer game for beginners of any age. The Spracklens have done a magnificent job: Reversal is everything I expected it to be when I saw who had brought it into the world.

Conclusions

- Reversal is capable of competing evenly with players of any level.
- Instructions and documentation for Reversal are better than average, but a "quick reference" table of commands would help inexperienced users. Running the game is complicated by only one fact: it is assumed you know that the disk uses Apple's DOS 3.2. An unusually large number of disk accesses occur before anything happens, so the first-time user might experience some anxiety.
- Use of graphics and the game paddle make this game well-engineered for human use, but a feature for saving unfinished games on disk would avoid making the player record, then reenter the positions of all the pieces. Other improvements could include allowing the player to change the strategy level during play and a command to end the game and reload the program.■

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The Microcomputer as a Laboratory Instrument

Daniel Cosgrove
Botany Department
University of Washington
Seattle WA 98195

During the past three years we have actively used a microcomputer to study the biophysics of plant growth. The unit serves as a data-acquisition and stimulus-control system, as well as an analytical tool for processing and studying the resulting data. But why use a computer? Specifically, why use a microcomputer?

As a laboratory tool, the computer may be likened to a "smart" strip-chart recorder. That is, the computer not only stores data coming in from many different instruments (making it equivalent to not one but many chart recorders), but also controls external devices. For example, the microcomputer that we use in our laboratory regulates the timing and intensity of experimental light treatments given to plants. In addition, the computer permits easier, more subtle interpretations of the data involving mathematical transformations and statistical analysis.

In the past, such processes were severely limited by time and manpower. The availability of data in digital form makes sophisticated processing, such as signal averaging, smoothing, digital filtering, and curve-fitting, much easier. Thus the computer improves both the quantity and quality of experiments. In the last decade, the minicomputer has invaded the laboratory to perform these functions and more.

The reason for selecting a microcomputer is price—they sell for a fraction of the cost of a minicomputer. Yet in many cases they have all the required capabilities. Their biggest limitation in the laboratory is one of software—programs useful to the researcher are scarce. The first part of this article will give an overview of the microcomputer as it is used in our lab; this is followed by a description of the hardware and software architecture of the system.

System Overview

The primary use of our laboratory microcomputer (see photo 1) is to control experiments and acquire data. A typical experiment would involve the continuous measuring of the growth rate (and other parameters) of several plants over a 24- to 48-hour period, while subjecting the plants to various conditions such as light of different intensities or solutions of different osmotic strengths.

At the beginning of an experiment, the plants are connected to growth transducers, which are then connected to a multichannel A/D (analog-to-digital) converter in the computer. A BASIC program prompts the operator for the parameters of the experiment (eg: how many channels to sample, how often to sample, how many sampled points to average, when to turn the lights on and off, the total duration of the experiment) and feeds these values to the interrupt-driven

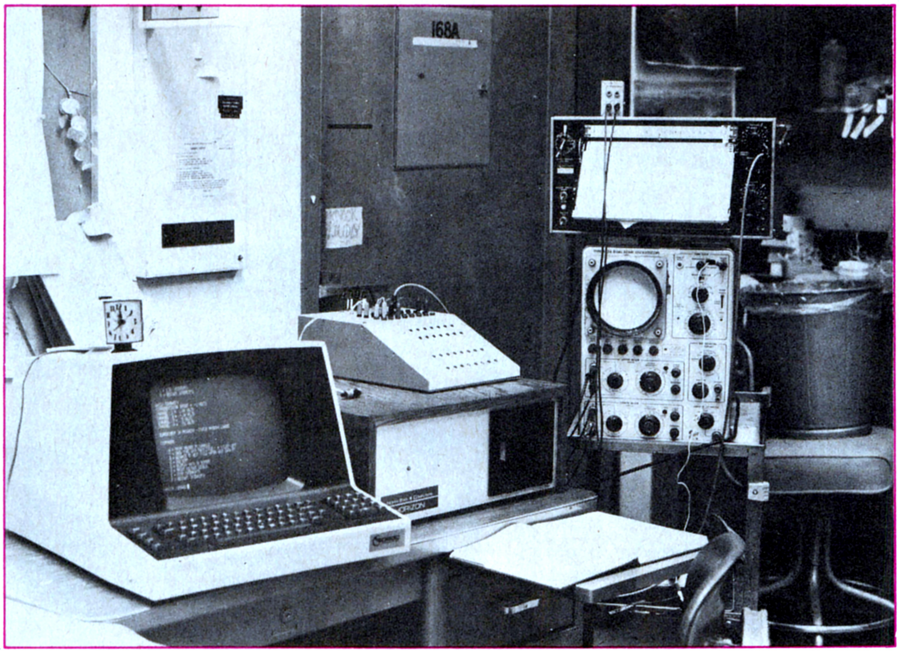

Photo 1: *View of the laboratory microcomputer, showing the Soroc video console, Horizon II computer, interface box, and oscilloscope and strip-chart recorder used for graphic display of data. Plant growth transducers and other instruments located in a controlled-temperature room behind the computer are plugged into the interface box on top of the Horizon.*

Acknowledgments

The author gratefully acknowledges the financial support of the National Science Foundation Graduate Fellowship, as well as the National Science Foundation Grant PCM 78-03244 awarded to Dr Paul Green of Stanford University.

assembly-language program that does the real work of the experiment. When the operator is satisfied with the experimental parameters, the BASIC program will start the sampling program.

Because the sampling program is an interrupt-driven routine, data acquisition can occur while BASIC works on a completely different program. This sampling will be completely transparent to the BASIC program and to the operator because the assembly routines are fast (the worst-case time required is less than one millisecond) and take up only a small portion of the processor's time (depending, of course, on the sampling rate), while the rest of the time is devoted to the BASIC (or other) program. This allows the operator to use BASIC for other tasks, or to run a program in BASIC that monitors the status of the experiment and permits the alteration of the progress of the experiment.

Using the video terminal, oscilloscope, or strip-chart recorder as display devices, this STATUS program can display the data collected by the sampling program. Photos 2 through 4 compare the three types of graphic displays. The oscilloscope and strip chart both have high resolution; the latter is used when hard copy is required. The video display has low resolution, but is useful when the other devices are not handy, and if you want to perform a simultaneous comparison of the data from different channels.

The data-acquistion programs are very flexible, allowing a wide range of sampling rates (up to three kHz) and control of up to sixteen different programmed events during the course of a sampling period. In addition, sampling periods may be automatically concatenated—with each period having its own parameters. I use this feature in my experiments on the effect of light on plant growth: high-frequency sampling during and shortly after the light treatment is alternated with lower-frequency sampling during the dark interval between light treatments. In addition, data points are averaged over a longer time span during the dark period, which saves both disk storage and processing time yet still provides the background growth-rate information I need.

After the computer has completed

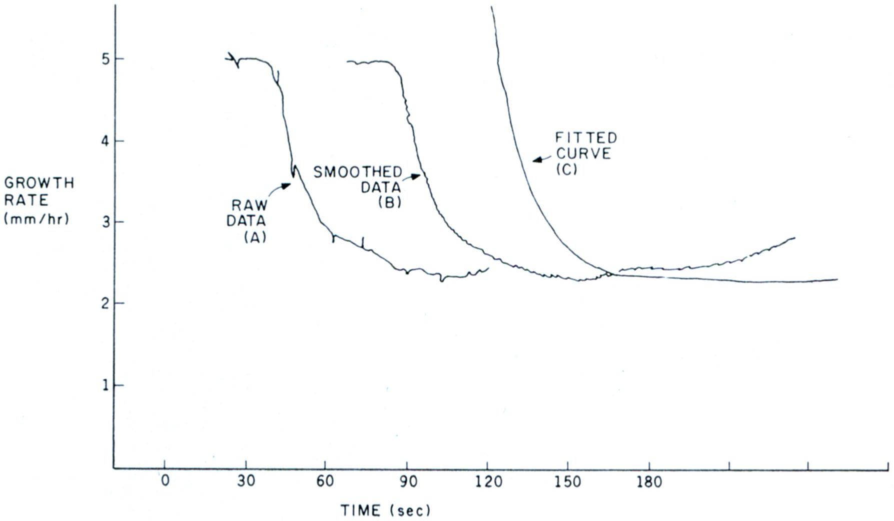

Figure 1: *Sample of data obtained using the acquisition system that appears in photo 1. The results of data smoothing and curve fitting performed on raw statistical data can be aided by the use of a microcomputer. Curve A shows the raw data of a plant's growth response to blue light; curve B shows the same data after smoothing to eliminate noise; curve C is derived from a computer fit of the data to an equation of an exponential decay of the growth rate to a lower rate.*

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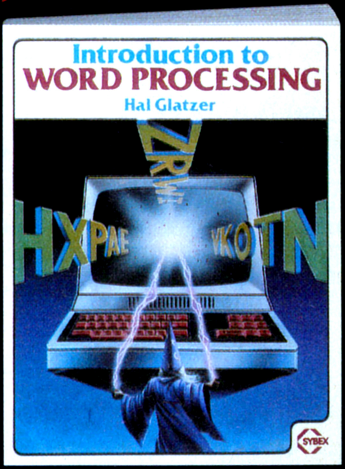

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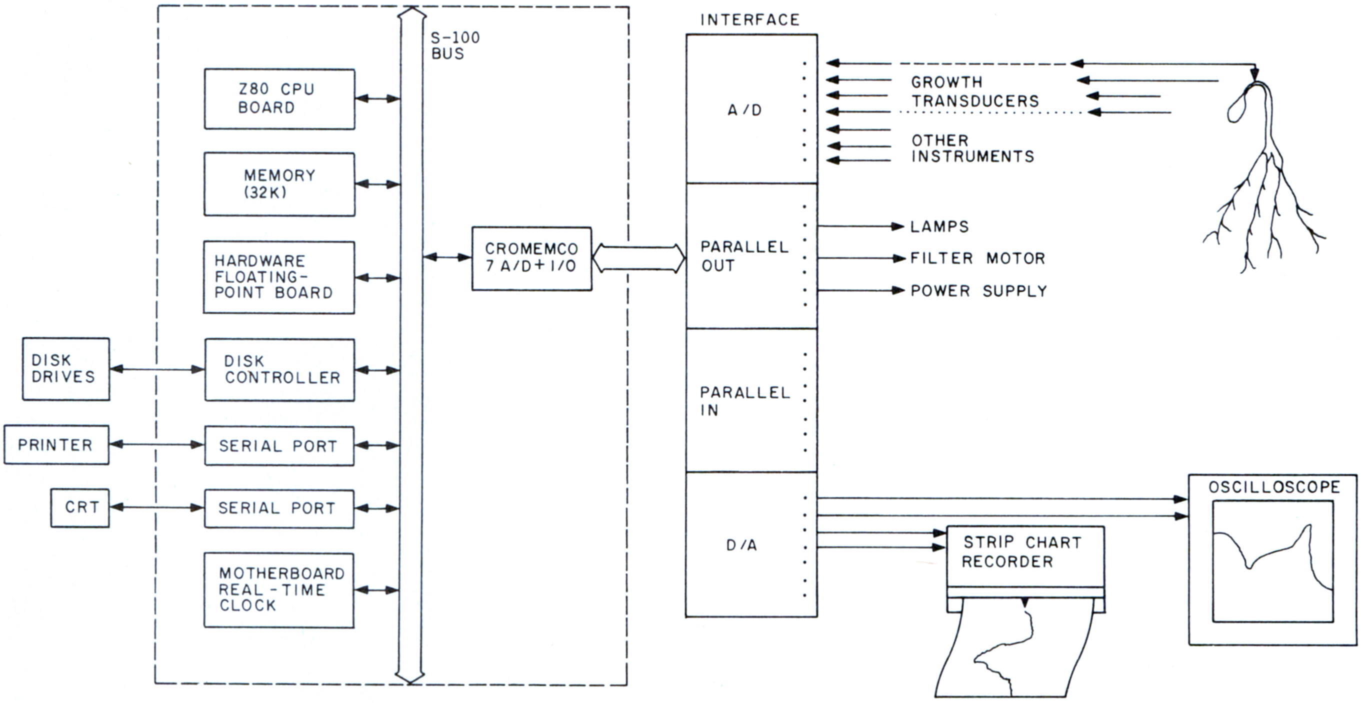
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LAMPS
FILTER MOTOR
POWER SUPPLY
PARALLEL IN
D/A
STRIP CHART RECORDER
OSCILLOSCOPE

Figure 2: *Block diagram of the hardware and peripherals used in the author's data-acquisition system.*

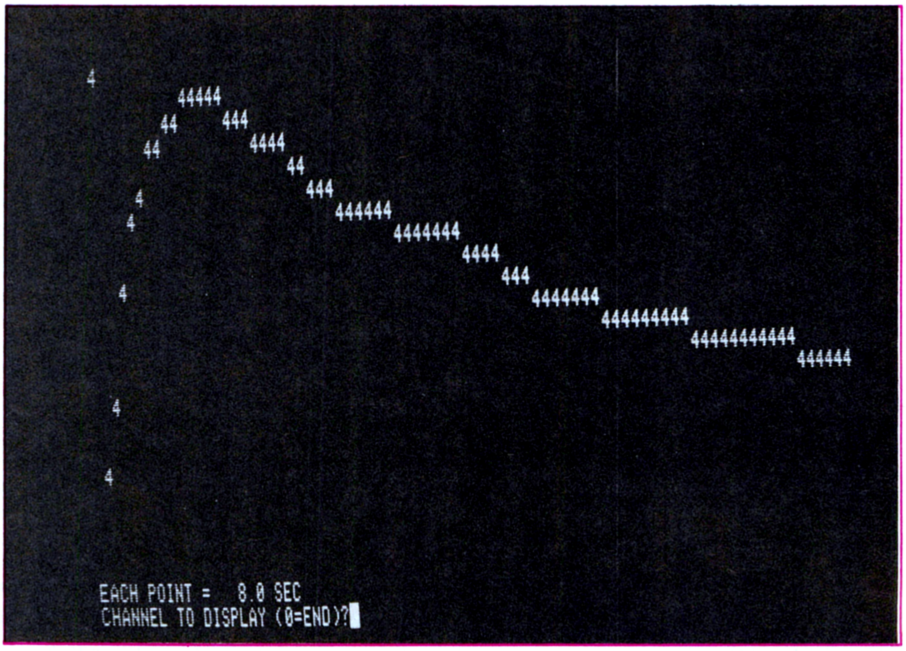
an experiment, it can shut off its own power by activating a latching relay. The data that have been collected and stored on disk can subsequently be examined and processed. In our lab, such processing involves smoothing the data and fitting it to exponential curves using statistical methods. An example of this process appears in figure 1.

In the laboratory, the microcomputer is a powerful tool for data acquisition, processing, and analysis. The two major tasks involved in setting up such a tool are interfacing the computer to the lab instruments and writing the programs for data acquisition. These tasks are described in the following sections.

Hardware Requirements

What are the hardware requirements of the system? Figure 2 diagrams the setup. The microcomputer is a North Star Horizon, which uses the Zilog Z80A microprocessor as the central processor, with dual 5-inch floppy-disk drives and 32 K bytes of user memory as peripherals. The FPB (hardware floating-point board) is an optional peripheral that speeds up mathematical programs in BASIC. The Cromemco D+7A I/O (input/output) board provides a 7-channel A/D (analog-to-digital) converter for accepting voltage signals from lab instruments, a 7-channel D/A (digital-to-analog) converter for outputting the stored data to display devices, and an 8-bit parallel port used in the lab for turning external devices on and off.

An interface between the Cromemco board and the "real world" was built to protect the board from dangerous external voltages and to facilitate connecting instruments to it. The interface is shown in photo 5 and its schematic appears in figure 3. The analog inputs are protected by zener diodes that are in series with light-



```
EACH POINT =  8.0 SEC
CHANNEL TO DISPLAY (0=END)?
```

Photo 2: *Sample display of data on the Soroc system console using the terminal's direct X-Y cursor-positioning ability.*

emitting diodes. The zeners conduct current across the light-emitting diodes when the input voltage is outside the −2.7 to +2.7 V range. This protects the circuits on the A/D board and gives a visual signal to indicate either over- or undervoltage conditions.

The analog outputs are used for graphic displays of digital data by plugging an oscilloscope or strip-chart recorder into the output jacks on the interface box. The parallel port, which is used to turn lights and other devices on and off, is isolated from outside currents by optical couplers and reed relays. The reed relays can handle up to 0.75 A and 240 V. For the larger currents used by the 500 W lamps, the relays turn on triacs (bidirectional thyristors or silicon-controlled rectifiers) that can handle up to 15 A. (For those interested in reading more about interface circuits, I have included several references at the end of the article.) As you can see, most I/O for experiments is handled via the Cromemco board and its interface box.

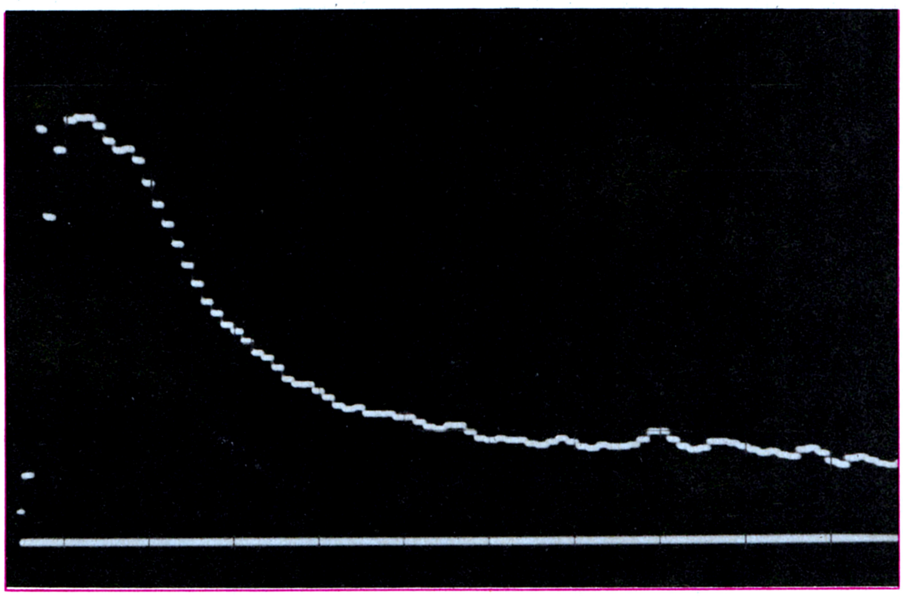


Photo 3: *Graphic display of data on the oscilloscope.*

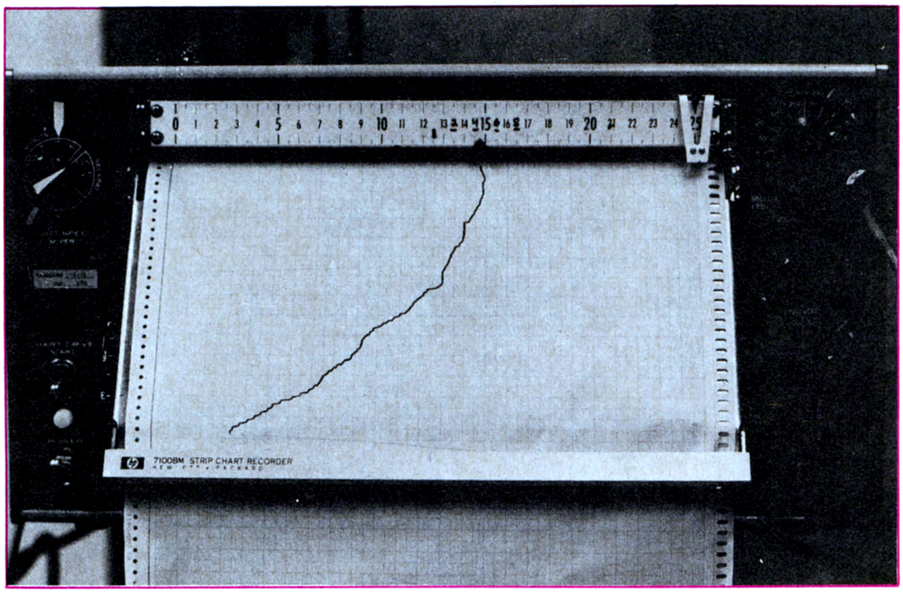


Photo 4: *Graphic display of data on the strip-chart recorder.*

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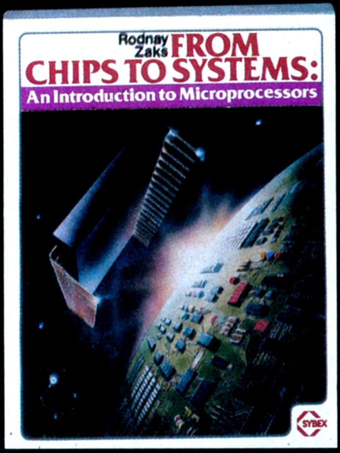
SYBEX PERSPECTIVE



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The Horizon has a useful built-in interval timer (a so-called "real-time clock") located on the motherboard, which makes periodic sampling easy. To provide the clock-interrupt capability required by the data-acquisition program, the real-time clock flag is connected to one of the seven interrupt lines (V3) on the motherboard. The flag may then be enabled or disabled under program control (ie: it is armed while sampling is going on, but disarmed at other times).

One note of caution: whenever interrupts, either from the clock or other device, are enabled, the North Star Hardware Floating Point Board may not be used with reliability. In using North Star's special version of BASIC (called FPBASIC), which accesses the floating-point board, I found that the board sporadically returned erroneous results when interrupt sampling was occurring. (This happens when a clock interrupt falls in the middle of data transmission between the board and FPBASIC.) The sampled data, fortunately, is not affected, and use of standard BASIC instead of FPBASIC circumvents this problem.

Also to be considered is the fact that interrupts during disk activity may cause detected read errors as well as undetected write errors. As a consequence, the data-acquisition program described below always disables interrupts before attempting to write the data out to disk. This is necessary to insure error-free data transmission.

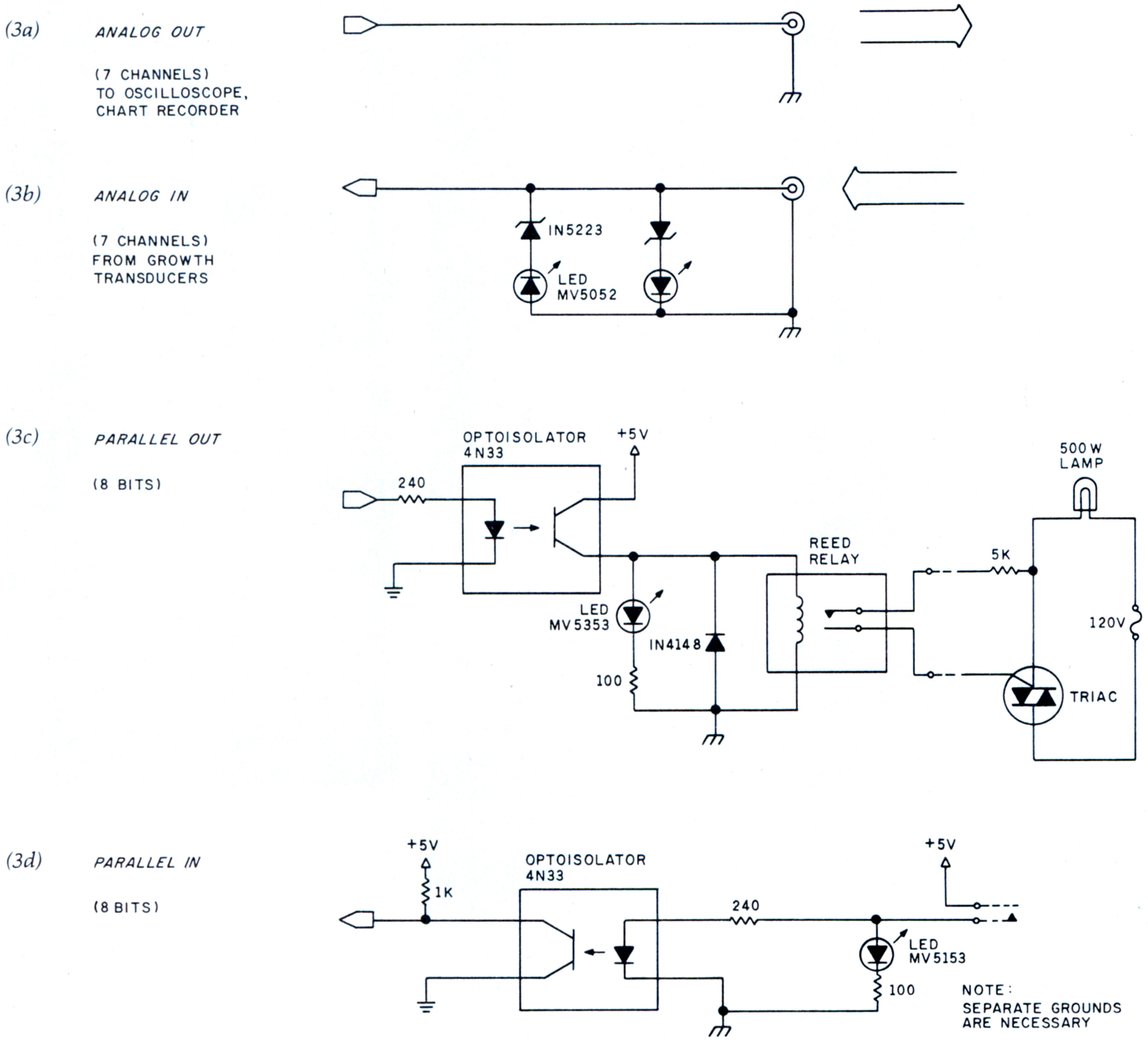

(3a)
ANALOG OUT
(7 CHANNELS) TO OSCILLOSCOPE, CHART RECORDER
(3b)
ANALOG IN
(7 CHANNELS) FROM GROWTH TRANSDUCERS
IN5223
LED MV5052
(3c)
PARALLEL OUT
(8 BITS)
OPTOISOLATOR 4N33
+5V
240
LED MV5353
IN4148
100
REED RELAY
5K
500W LAMP
120V
TRIAC
(3d)
PARALLEL IN
(8 BITS)
+5V
1K
OPTOISOLATOR 4N33
240
+5V
LED MV5153
100
NOTE: SEPARATE GROUNDS ARE NECESSARY

Figure 3: *Schematic diagrams of the four types of I/O channels used on the laboratory microcomputer. Figure 3a is the analog output from the Cromemco 7 A/D + I/O board to the graphics peripheral (this circuit is duplicated for 7 analog output channels). Figure 3b is the analog input interface that connects the Cromemco board to the various data-acquisition devices; the zener diodes protect the analog input circuitry on the board from overvoltages, while the LEDs indicate this danger condition (also duplicated for 7 channels). Figure 3c shows a relay controller operated from one bit of a parallel output port (duplicated for 8 channels). Figure 3d is the parallel input port interface (duplicated for 8 channels). Both of these interfaces protect the computer through the use of optical isolators.*

We use a Soroc IQ 120 terminal to communicate with the computer and a Teletype model ARS 33 as a printer.

Software Description

The special software used for laboratory experiments includes a variety of assembly-language programs as well as BASIC programs. The assembly-language data-acquisition programs (see listing 1) were developed using Xitan's (formerly TDL) editor and Z80 macroassembler under a CP/M operating-system environment. All of the programs were designed to use the North Star DOS (disk operating system) library routines for writing to and from disks. Similarly, all of the BASIC programs use North Star BASIC (see listings 2 through 4). The data-acquisition routines in machine language are located in a different portion of memory from that used by BASIC (see memory map in figure 4). Thus, both may function during an experiment.

For the purpose of maximum flexibility, the laboratory software was designed as a number of modules that pass information to each other. As seen in the left half of figure 5, the sampling programs consist of three main modules: INTERRUPT HAN-

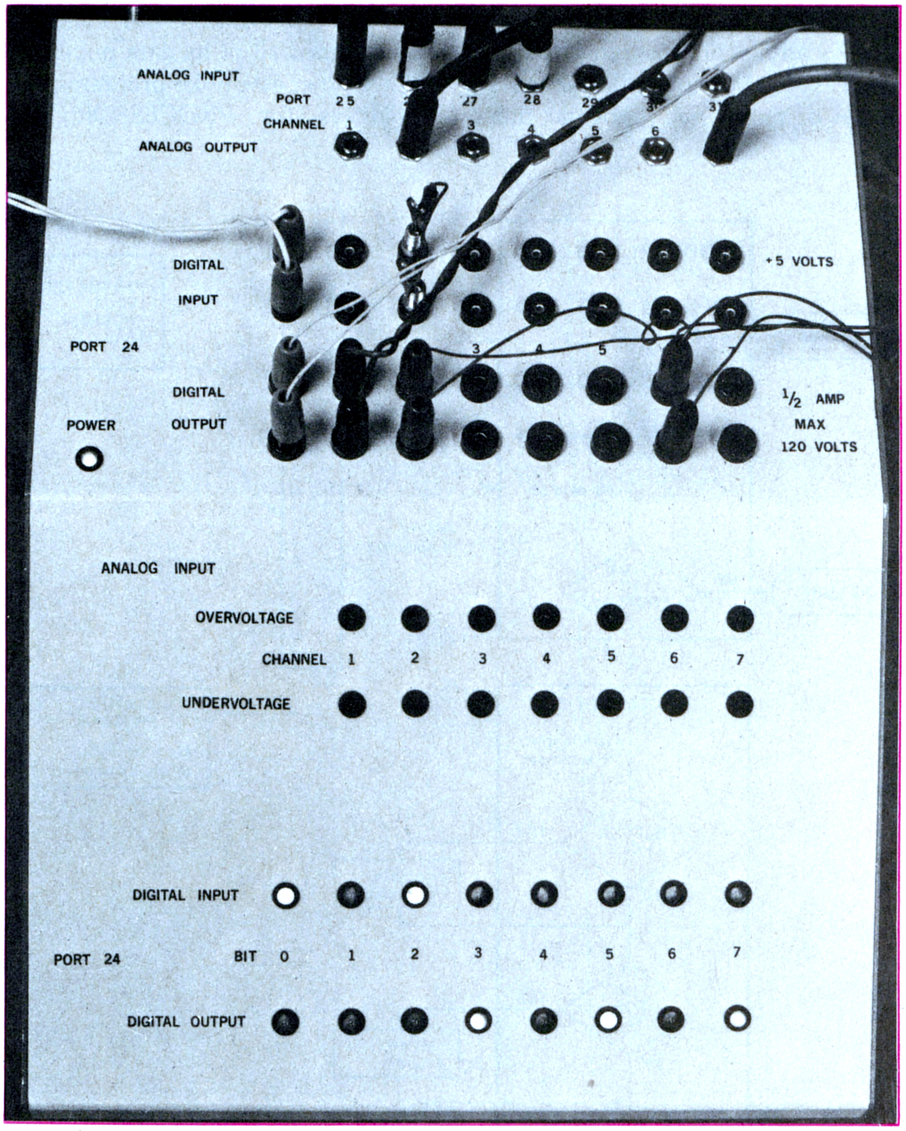
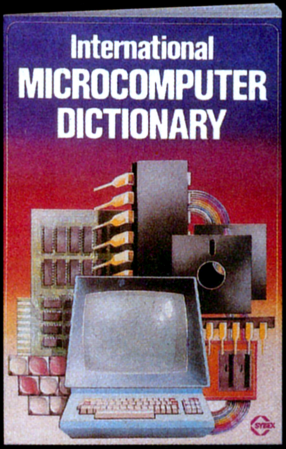

ANALOG INPUT
PORT 25 27 28 29 31
CHANNEL 1 3 5 6
ANALOG OUTPUT
DIGITAL INPUT
+5 VOLTS
PORT 24
3 4 5
DIGITAL OUTPUT
½ AMP MAX 120 VOLTS
POWER
ANALOG INPUT
OVERVOLTAGE
CHANNEL 1 2 3 4 5 6 7
UNDERVOLTAGE
DIGITAL INPUT
PORT 24
BIT 0 1 2 3 4 5 6 7
DIGITAL OUTPUT

Photo 5: *Close-up of the interface box. Instruments to be sampled are plugged into the computer's analog input jacks. Voltages outside the range of the A/D converter are indicated by the overvoltage or undervoltage LEDs. A display of graphic data may be obtained by plugging an oscilloscope or a strip-chart recorder into the analog output jack. Lamps, motors, and other devices are turned on and off by the digital output relays.*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DLER, SAMPLER, and PROCESSOR. The first module keeps track of when data needs to be recorded, the second records the data, and the third saves the data on disk and calls special event programs.

The sampling routines function as follows (see the flowchart in figure 5): the real-time clock requests an interrupt, which causes a jump to the INTERRUPT HANDLER program. This is handled by the vectored priority-interrupt capability of the North Star Z80 processor. The INTERRUPT HANDLER decrements a timing counter and checks to see if it's time to sample. If not, the computer returns to the job it was working on before the interrupt. If it is time to sample, the SAMPLER routine is entered.

The SAMPLER routine reads data from each active channel of the A/D board and sums them with previous data stored in a temporary double buffer. This feature allows the program to do on-line averaging of from 1 to 256 points before storing the resulting values. For instance, if 16 points are to be averaged, SAMPLER is entered sixteen times. The first fifteen times SAMPLER adds the new samples to the old ones and returns immediately to the pre-interrupt job. On the sixteenth time, the routine does the summation of the new data with the sums of the old, changes an internal pointer to the other half of the double buffer, and enters PROCESSOR.

PROCESSOR has several functions. It performs the averaging of the data from each of the channels and stores this average value in the main buffer. When the buffer is full, it calls on subroutines that write the buffer out to disk. In addition, PROCESSOR keeps track of the time and the locations of programs that execute special events (like activating lights or pumps) at particular times. For instance, when PROCESSOR is initialized, it is loaded with the locations of these special programs and the time to execute them. When the time for a particular event elapses, PROCESSOR will call the location that controls the event. After checking the time of all events, PROCESSOR returns to the pre-interrupt location.

The use of a double buffer by SAMPLER permits data points to be summed and stored in one half of the buffer while PROCESSOR is still working on the other half of the double buffer. The only restriction of this system is that PROCESSOR must finish with its half of the double buffer before SAMPLER has collected and summed all of its data points.

Two other assembler programs, the initializers for PROCESSOR and

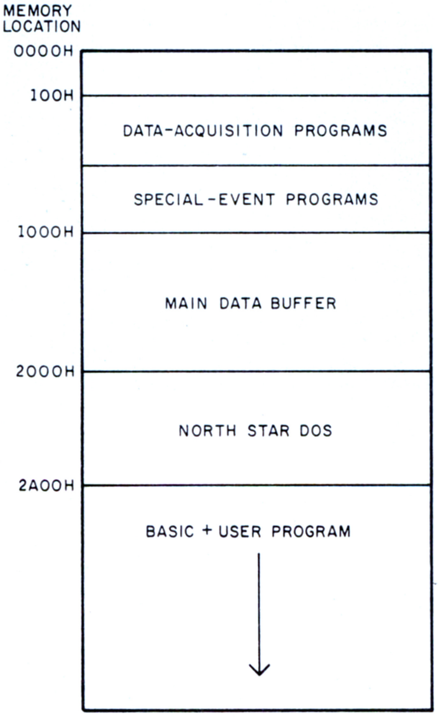

MEMORY LOCATION
0000H
100H
DATA-ACQUISITION PROGRAMS
SPECIAL-EVENT PROGRAMS
1000H
MAIN DATA BUFFER
2000H
NORTH STAR DOS
2A00H
BASIC + USER PROGRAM

Figure 4: *Memory map that shows the hexadecimal memory locations of the machine-language acquisition programs, North Star operating system, and BASIC.*

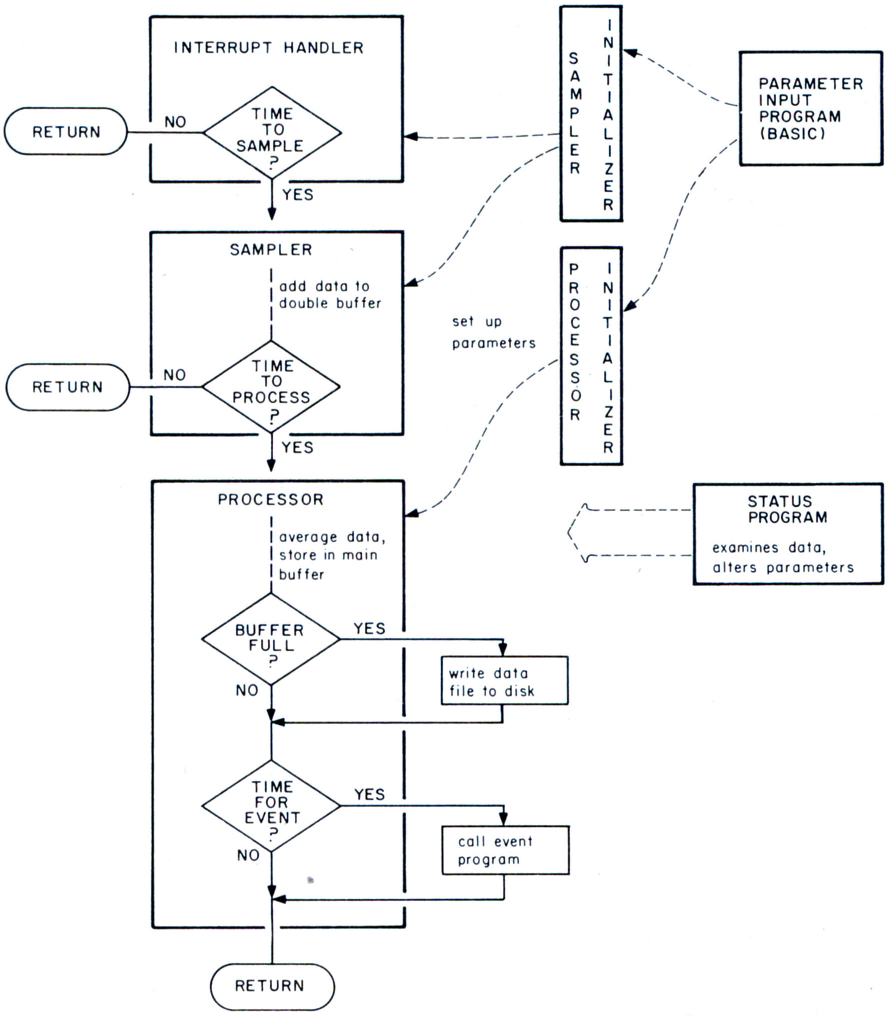

INTERRUPT HANDLER
TIME TO SAMPLE ?
NO
RETURN
YES
SAMPLER
add data to double buffer
TIME TO PROCESS ?
NO
RETURN
YES
PROCESSOR
average data, store in main buffer
BUFFER FULL ?
YES
write data file to disk
NO
TIME FOR EVENT ?
YES
call event program
NO
RETURN
SAMPLER INITIALIZER
PARAMETER INPUT PROGRAM (BASIC)
set up parameters
PROCESSOR INITIALIZER
STATUS PROGRAM
examines data, alters parameters

Figure 5: *Flowchart of the machine-language data-acquisition programs and their interface with BASIC.*

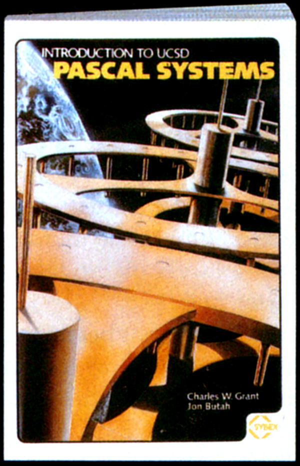
Circle 397 on inquiry card.

Listing 1: *Z80 machine-language program that contains the subroutines necessary for maintaining an interrupt-driven data-acquisition system. Among these subroutines is an interrupt-handler, a data sampler, and a data-storage and special-event processor. The design includes provisions for interfacing with BASIC programs. This version was written using a TDL (Xitan) assembler, hence the TDL Z80 mnemonics.*

```
                      ;************************************
                      ;**                                **
                      ;**          DATAQU                **
                      ;**                                **
                      ;************************************
                      ;
                      ;SETS UP PARAMETER LOCATIONS AND CALLS
                      ;UTILITY PROGRAMS
                      ;
                              .PABS
0100                          .LOC     100H
                      ;
                      ;
                      ;OUTPUT MESSAGE AND RETURN TO DOS.
                      ;REQUIRED FOR PROPER LOADING BY DOS.
                      ;
2028                  DOS = 2028H      ;DOS ENTRY POINT
                      ;
                      ;
0100    21 0109               LXI      H,..MESS         ;OUTPUT MESSAGE
                                                        ;TO CONSOLE
0103    CD 047A               CALL     MESSOUT ;
0106    C3 2028               JMP      DOS      ;RET TO DOS
                      ;
0109    3E2044415441  ..MESS: .ASCIZ   /> DATA AQUISITION PRGM (VERS. 1
                      .2) LOADED
0132    0D0A
0134    0D0A00        /
                      ;TABLE OF CONSTANTS AND VARIABLES:
                      ;
0137                  CHNL:   .BLKB    1        ;# OF CHNLS TO SAMPLE
0138                  INT$S:  .BLKB    1        ;# INTRRPTS/SAMPLE
0139                  S$DPT:  .BLKB    1        ;# SAMPLES/DATA PT
013A                  SCNTR:  .BLKB    1        ;SAMPLE COUNTER
013B                  DIVSR:  .BLKB    1        ;PROCESSING CODE
013C                  N$EVTS: .BLKB    1        ;# PROGRAMMED EVENTS
013D                  ETIME:  .BLKW    32D      ;EVENT TIME 1 (2 BYTES)
                                                ;ADDR EVENT 1 PRGM
                                                ;...ETC.. TO EVENT
                                                ;   #N$EVTS
017D    1000          BFSTRT: .WORD    1000H    ;START ADDR MAIN BUFF
017F    1000          MBUFPT: .WORD    1000H    ;MAIN BUFFER POINTER
0181    01C8          OTMPAD: .WORD    TMPBF1   ;OLD BUFFER POINTER
0183    01E8          NTMPAD: .WORD    TMPBF2   ;NEM BUFFER POINTER
0185    202020202020  FLNAME: .ASCII /            / ;FILENAME W/BLANK
                      ;
                      ;
                      ;


                             .INSERT B:INTHDLR
                     @;*******************************************
                     @;*
                     @;********************************************
                     @;*                                          *
                     @;*  INTERRUPT HANDLER & SAMPLER ROUTINE     *
                     @;*                                          *
                     @;********************************************
                     @;
                     @;THIS ROUTINE IS ENTERED BY CLOCK INTERRUPT.
                     @;IT COUNTS THE # OF INTERRUPTS SINCE THE
                     @;LAST SAMPLE WAS TAKEN.  WHEN THE INTERRUPT
                     @;COUNT = #INT/SAMPLE (AS SET UP BY "INIT")
                     @;THEN DATA IS INPUT FROM EACH OF THE ACTIVE
                     @;CHANNELS OF THE CROMEMCO D+7A I/O BOARD.
                     @;MODIFIED DATA IS SUMMED WITH PREVIOUS DATA AND
                     @;STORED BACK IN THE BUFFER.  WHEN THE BUFFER
                     @;IS FULL (IE # OF SAMPLES TAKEN EQUALS
                     @;SAMPLES/DATA PT) THEN THE BUFFER ADDR'S ARE
                     @;UPDATED AND CONTROL GOES TO THE "PROCESSOR".
                     @;
                     @;B'= INTERRUPT COUNTER
                     @;
018E    D9           @INTHLD: EXX               ;SAVE REGS
018F    08           @        EXAF              ;
0190    3E50         @        MVI     A,50H     ;RESET CLOCK FLAG
0192    D306         @        OUT     6
0194    05           @        DCR     B         ;TIME TO SAMPLE?
0195    2805         @        JRZ     SAMPLE    ;YES
0197    D9           @        EXX               ;NO,RESTORE REGS
0198    08           @        EXAF              ;
0199    FB           @        EI                ;
019A    ED4D         @        RETI
                     @;
                     @;SAMPLER;  FOR THE FOLLOWING SECTION OF CODE
                     @;REGISTERS ARE USED AS FOLLOWS:
```

Listing 1 continued on page 93



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SAMPLER, are shown in figure 5. These routines make it easy for BASIC to send the required sampling parameters to the data-acquisition program, to initialize the Z80 processor's alternate register set used by those routines, and to enable interrupts so that sampling may begin. The BASIC program communicates with these two initializers by first creating in memory a table that consists of the appropriate values of the parameters (obtained by prompting the operator). It then uses the CALL function to jump to the initializer and sends the address of the table in the DE register pair.

Once sampling has begun, a BASIC program can also follow the course of sampling, displaying the data contained in the PROCESSOR main buffer, altering some of the sampling parameters, stopping sampling, or terminating the experiment (which causes the data in the buffer to be saved on disk).

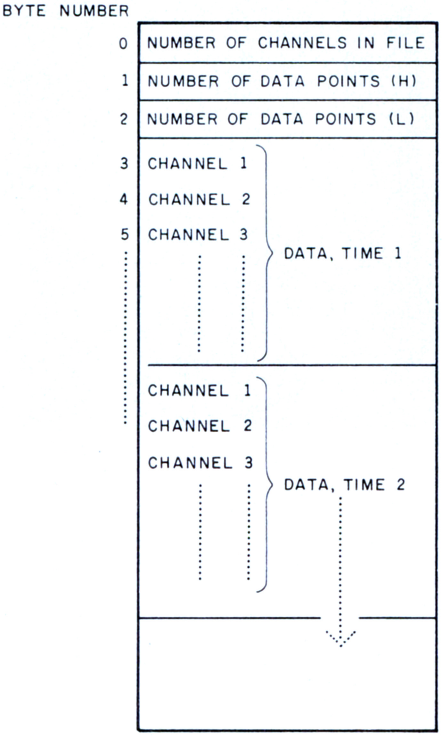

Figure 6: *Map of the structure of the data file used by the author's programs. Three file-information bytes precede the actual data in the file.*

Data File Structure

When the main data buffer is full or the sampling period is finished, three file-information bytes are placed in front of the buffer and it is written directly to disk using the North Star DOS library routines. The resulting disk-file structure is shown in figure 6. The first byte indicates how many channels (in binary encoding) are sampled in the file. The next two bytes indicate the total number of data points (in bytes) in the file (again, binary encoded, high byte followed by low byte). Each of the following bytes is a data point, represented in two's-complement notation, which is the form of the data returned by the Cromemco A/D board. If the number of channels in a file record is N, then the data for channel 1 will be found at every Nth byte, beginning at the fourth byte; similarly for channel 2, which begins at the fifth byte, and so on for all N channels.

There are two ways for a BASIC program to access the data in the file. North Star BASIC has a byte-access facility, so the data may be read a byte at a time by a READ statement. Alternatively, the data may be written from disk to memory, and then the EXAM (or PEEK, as it is called in some BASICs) function can read the data. I use this latter method: it reduces disk accesses and permits the graphic display on the oscilloscope to be done by fast machine-language routines.

Once the data is read into BASIC, almost any kind of manipulation can be done. As an example, curve A in figure 1 shows the raw data of the growth response of a sunflower seedling to a short pulse of light. Curve B shows the same data after smoothing (using a 9-point moving weighted average), and curve C shows the output of a program that fits the data to a first-order exponential decay to a lower asymptote.

Other Uses

I've discussed how the computer has been used in the laboratory for data acquisition, experiment control, and data processing, and up to this point the controller aspects of the computer have been fairly rudimentary. Primarily, it has been functioning as a timer to turn devices on and off.

The next level of complexity involves having the computer examine the data as it comes in, and exert its control options contingent upon what the data look like. For example, a BASIC program could study the data contained in the main data buffer. When it detects a certain pattern, say an oscillation or the peak of an oscillation, it could then turn on a lamp or apply a voltage to electrodes; the only limit to the complexity of the controlling features is in the program itself.

In addition to these uses, the microcomputer can assist the researcher in other ways. Small- to medium-sized mathematical modeling programs can be run on these machines. A bibliography program could help the researcher keep notes in useful, accessible order. A text editor can be used to write articles. Finally, for those jobs that require a larger computer, the microcomputer can collect the primary data, then transmit the data at high speed to the mainframe computer. ■

---

1. Balcom, Orv. "Interfacing a Microcomputer to the Analog World." *Interface Age*, July 1978, pages 68-75.
2. Olson, Hank. "Controlling the Real World." March 1978 BYTE, pages 174-177.
3. Titus, J; P Rony; C Titus; D Larsen. *Microcomputer-Analog Converter Software and Hardware Interfacing*. Indianapolis: Howard W Sams & Co Inc, 1978.

Readers may obtain the programs and complete source listings as shown in this article at a nominal copying fee from the North Star Software Exchange, North Star Computer Co, Berkeley CA 94710.

Listing 1 continued:

```
                        @;
                        @;         A<=INPUT DATA
                        @;         B<=CHANNEL COUNTER
                        @;         C<=I/O PORT ADDR
                        @;        DE<=DATA W/SIGN BIT COMPLEMENTED
                        @;        HL<=PREVIOUS BUFFER DATA
                        @;         X<=ADDR OF BUFFER DATA (ADRDAT)
                        @;
019C      DDE5          @SAMPLE:   PUSH     X        ;SAVE REG
019E      DD2A 0183     @          LIXD     NTMPAD   ;LOAD BUFFER ADDR
01A2      0E19          @          MVI      C,31Q    ;CHANNEL ADDR=31 OCT
01A4      3A 0137       @          LDA      CHNL     ;#CHANNELS
01A7      47            @          MOV      B,A      ;INTO B
01A8      1600          @          MVI      D,0      ;CLEAR
                        @;
                        @;
01AA      DD22 01B3     @FETCH:    SIXD     ADRDAT+1 ;STORE ADDR
01AE      DD22 01BC     @          SIXD     STDAT+1  ;
01B2      2A 0000       @ADRDAT:   LHLD     0000     ;GET DATA WHOSE ADDR IS
                        @                            ;STORED HERE(0 NOT REAL
                        @                            ;ADDRESS)
01B5      ED78          @          INP      A        ;
01B7      EE80          @          XRI      128D     ;COMPL SIGN BIT
01B9      5F            @          MOV      E,A      ;
01BA      19            @          DAD      D        ;ADD TO OLD DATA
01BB      22 0000       @STDAT:    SHLD     0000     ;STORE DATA AT ADDR
                        @                            ;STORED HERE (0 NOT
                        @                            ;REAL ADDR)
01BE      05            @          DCR      B        ;ALL CHNLS SAMPLED?
01BF      2847          @          JRZ      COUNT    ;YES
01C1      DD23          @          INX      X        ;NO,UPDATE BUF ADDR
01C3      DD23          @          INX      X        ;
01C5      0C            @          INR      C        ;UPDATE PORT ADDR
01C6      18E2          @          JMPR     FETCH    ;LOOP TILL DONE
                        @;
                        @;
01C8                    @TMPBF1:   .BLKW    16D      ;BUFFER 1
01E8                    @TMPBF2:   .BLKW    16D      ;BUFFER 2
                        @;
                        @;
                        @;DATA IS NOW LOADED AND STORED IN TEMP BUF
                        @;
0208      DDE1          @COUNT:    POP      X        ;RESTORE X
020A      3A 0138       @          LDA      INT$S    ;REINITIALIZE
020D      47            @          MOV      B,A      ;INTRPT CNTR
020E      3A 013A       @          LDA      SCNTR    ;TIME TO PROCESS?
0211      3D            @          DCR      A        ;
0212      280E          @          JRZ      UPDATE   ;YES,DO PROCESS
0214      32 013A       @          STA      SCNTR    ;NO,STORE SAMPLE CNTR
0217      DB06          @          IN       6        ;CHECK CLOCK FLAG
0219      CB57          @          BIT      2,A      ;
021B      202B          @          JRNZ     CLK2FS   ;CLOCK TOO FAST
021D      D9            @          EXX               ;OK,RESTORE REGS
021E      08            @          EXAF              ;
021F      FB            @          EI                ;ENABLE INTERRUPTS
0220      ED4D          @          RETI              ;RETURN
                        @;
                        @;
                        @;THIS SECTION ENTERED WHEN TEMP BUFFER
                        @;IS FILLED.  IT UPDATES TEMP BUFFER ADDRS
                        @;AND SAMPLE COUNTER.
                        @;
0222      2A 0183       @UPDATE:   LHLD     NTMPAD   ;SWITCH BUF ADDRS
0225      ED5B 0181     @          LDED     OTMPAD   ;
0229      22 0181       @          SHLD     OTMPAD   ;
022C      ED53 0183     @          SDED     NTMPAD   ;
0230      3A 0139       @          LDA      S$DPT    ;INITIALIZE SAMPLE
0233      32 013A       @          STA      SCNTR    ;  COUNTER
0236      3EFF          @          MVI      A,255    ;SET OVERFLOW FL
0238      32 0247       @          STA      OVFLAG   ;
023B      DB06          @          IN       6        ;CHK CLOCK FLAG
023D      CB57          @          BIT      2,A      ;
023F      2007          @          JRNZ     CLK2FS   ;CLOCK TOO FAST
0241      D9            @          EXX               ;OK,RESTORE REG
0242      08            @          EXAF              ;
0243      FB            @          EI                ;ENABLE INTRPTS
0244      C3 02DD       @          JMP      PROCSR   ;GOTO PROCESSOR
                        @;
0247                    @OVFLAG:   .BLKB    1        ;OVERFLOW FLAG
                        @;
                        @;
                        @;****************************************
                        @;
                        @;CLOCK TO FAST; STOP SAMPLING; CUE
                        @;OPERATOR AND RET
                        @;
0248      F3            @CLK2FS:   DI                ;DISABLE INTRPTS
0249      21 0250       @          LXI      H,..MESS;OUTPUT MESSAGE
024C      CD 047A       @          CALL     MESSOUT ;
024F      C9            @          RET
                        @;
```

Listing 1 continued on page 94

Circle 397 on inquiry card.

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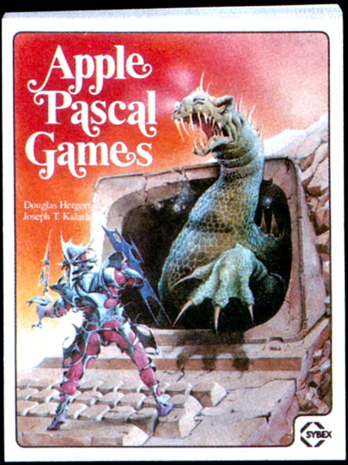
INSPIRING



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Listing 1 continued:

```
0250                @..MESS: .ASCIZ  /
0250    0D0A2A2A2A2A@****************************************
027C    0D0A        @
027E    0D0A53414D50@SAMPLING ABORTED: INTERRUPT RATE TOO FAST!
02AA    0D0A        @
02AC    0D0A2A2A2A2A@****************************************
02D8    0D0A        @
02DA    0D0A00      @/
                    @;       .INSERT B:PROCSR
                    @;****************************************
                    @;*                                      *
                    @;*           PROCESSOR                  *
                    @;*                                      *
                    @;****************************************
                    @;
                    @;THIS ROUTINE TAKES DATA FROM THE OLD TEMP
                    @;BUFFER OF "INTHDLR", CALLS "FNXN" TO PROCESS
                    @;IT, AND TRANSFERS THE PROCESSED DATA TO MAIN
                    @;BUFFER STORAGE.  IT KEEPS TRACK OF TIME
                    @;(BY # DATA PTS) AND CALLS SPECIAL EVENT
                    @;PROGRAMS AT THE APPROPRIATE TIMES.  WHEN
                    @;MAIN BUFFER FILLS UP, IT CALLS "DATWR"
                    @;TO WRITE THE DATA OUT TO DISK.
                    @;ALL REGISTERS ARE PRESERVED.  ANY USER
                    @;PROGRAM CALLED BY PROCSR MUST PRESERVE
                    @;THE IX AND IY REGISTERS, AS WELL AS ANY
                    @;OTHERS SPECIFIED AT THE CALLING POINT.
                    @;
02DD    ED73 035B   @PROCSR: SSPD    STKPT   ;STORE OLD STACK PNTR
02E1    31 0100     @        LXI     SP,100H ;LOAD NEW SP
02E4    F5          @        PUSH    PSW     ;SAVE REGISTERS
02E5    C5          @        PUSH    B       ;
02E6    D5          @        PUSH    D       ;
02E7    E5          @        PUSH    H       ;
02E8    21 0247     @        LXI     H,OVFLAG;CLEAR OVERFLOW FLAG
02EB    34          @        INR     M       ;
                    @;
                    @;SET UP REGISTERS FOR TRANSFER:
                    @;       ;
                    @;
                    @;       DE<=MAIN BUFFER POINTER
                    @;       BC<=# OF CHANNELS
                    @;       HL<=OLD TEMP BUFFER POINTER
                    @;        A<=PROCESSOR CODE
                    @;
02EC    ED5B 017F   @        LDED    MBUFPT  ;
02F0    0600        @        MVI     B,0     ;
02F2    21 0137     @        LXI     H,CHNL  ;
02F5    4E          @        MOV     C,M
02F6    2A 0181     @        LHLD    OTMPAD  ;FETCH OTMPAD
02F9    3A 013B     @NEXT:   LDA     DIVSR   ;
02FC    CD 041F     @        CALL    FNXN    ;DO # CRUNCHING
                    @                        ;DE, HL MUST BE SAVED
                    @                        ;ON RET, (HL) SHOULD
                    @                        ;CONTAIN THE DATA PT.
                    @                        ;HIGH BYTE OF DATA PT
                    @                        ;SHOULD BE 00 ON RET
                    @;
02FF    3E7F        @TRANSF: MVI     A,127D  ;CHECK OVERFLOW
0301    BE          @        CMP     M       ;
0302    CC 035D     @        CZ      BEEP    ;
0305    3E80        @        MVI     A,128D  ;CHECK UNDERFLOW
0307    BE          @        CMP     M       ;
0308    CC 035D     @        CZ      BEEP    ;
030B    EDA0        @        LDI             ;DO TRANSFER
030D    2B          @        DCX     H       ;
030E    3E00        @        MVI     A,0     ;CLEAR ACC
0310    77          @        MOV     M,A     ;CLEAR BUFFER
0311    23          @        INX     H       ;
0312    23          @        INX     H       ;
0313    EA 02F9     @        JO      NEXT    ;TILL DONE
                    @;
                    @;
0316    ED53 017F   @        SDED    MBUFPT  ;STORE MAIN BUF PNTR
031A    21 E000     @        LXI     H,-2000H;MAIN BUFFER FULL?
031D    19          @        DAD     D       ;SUBTRACT 8K
                    @                        ;MAIN BUFFER GOES
                    @                        ;FROM 1000H TO 2000H
031E    3A 0137     @        LDA     CHNL    ;ADD # CHANNELS
0321    C602        @        ADI     2       ;ADD TERMINATION BYTES
0323    0600        @        MVI     B,0     ;
0325    4F          @        MOV     C,A     ;
0326    ED4A        @        DADC    B       ;
0328    F4 0487     @        CP      DATWR   ;YES, WRITE OUT DATA
032B    FB          @        EI              ;ENABLE INTERRUPTS
                    @;
                    @;
                    @;CHECK IF TIME FOR PROGRAMMED EVENTS:
                    @;
032C    3A 013C     @        LDA     N$EVTS  ;LOAD A W/# EVENTS
032F    B7          @        ORA     A       ;=0?
```

Listing 1 continued:

```
0330    CA 034B    @          JZ      ..OUT     ;YES, OUT & RET
0333    47         @          MOV     B,A       ;B<=#EVENTS
0334    21 013E    @          LXI     H,ETIME+1;LOAD LOC OF LOW
                   @                            ;BYTE OF TIME
                   @;
                   @;
0337    3EFF       @..LOOP:   MVI     A,-1      ;SUBTRACT 1 FROM TIME
0339    86         @          ADD     M         ;
033A    77         @          MOV     M,A       ;
033B    D4 0366    @          CNC     HYDCR     ;NO CARRY: DECREMENT
                   @                            ;HIGH BYTE, RETURN WITH
                   @                            ;Z=0
033E    CC 0362    @          CZ      ENDCK     ;CHECK HIGH BYTE
                   @                            ;RET W/Z=1 IF 00
0341    CC 036B    @          CZ      ESTART    ;TIME FOR EVENT?
                   @                            ;HL MUST
                   @                            ;BE SAVED BY PRGMS.
0344    23         @          INX     H         ;INCREMENT POINTER TO
0345    23         @          INX     H         ;NEXT EVENT TIMER
0346    23         @          INX     H         ;   (LOW BYTE)
0347    23         @          INX     H         ;
0348    05         @          DCR     B         ;
0349    20EC       @          JRNZ    ..LOOP    ;LOOP TILL ALL EVENT
                   @                            ;TIMERS ARE PROCESSED
                   @;
                   @;
                   @;
034B    3A 0247    @..OUT:    LDA     OVFLAG    ;CHECK OVERFLOW FLAG
034E    B7         @          ORA     A         ;SET Z FLAG
034F    C4 0372    @          CNZ     OVFLOW            ;   OOH-OOH !!
0352    E1         @RSTORE:   POP     H         ;RESTORE REGS
0353    D1         @          POP     D         ;
0354    C1         @          POP     B         ;
0355    F1         @          POP     PSW       ;
0356    ED7B 035B  @          LSPD    STKPT     ;RESTORE OLD SP
035A    C9         @          RET               ;OK,RET TO STATUS
035B               @STKPT:    .BLKW   1         ;STORE OLD SP HERE
                   @;
                   @;*****************************************
                   @;
035D    3E07       @BEEP:     MVI     A,7       ;OUTPUT BELL TO CRT
035F    D302       @          OUT     2         ;
0361    C9         @          RET               ;
                   @;
                   @;
                   @;
                   @;****************************************
                   @;
                   @;ENDCK :  CHECKS THE HIGH BYTE OF A 16-BIT
                   @;WORD.  RETURNS WITH Z FLAG SET IF THE HIGH
                   @;BYTE = 0.  EXPECTS HL TO CONTAIN THE ADDR
                   @;OF THE LOW BYTE (WITH HIGH BYTE IN (HL-1).
                   @;REG A SHOULD EQUAL 00 ON ENTERING.
                   @;ALL REGS ARE PRESERVED.
                   @;
0362    2B         @ENDCK:    DCX     H         ;
0363    BE         @          CMP     M         ;
0364    23         @          INX     H         ;
0365    C9         @          RET               ;
                   @;
                   @;
                   @;
                   @;****************************************
                   @;
                   @;HYDCR: THIS SR SUBTRACTS ONE FROM  HIGH BYTE
                   @;OF A 16-BIT WORD.  EXPECTS HL TO POINT TO THE
                   @;LOW BYTE, WITH HIGH BYTE AT (HL-1).  ALL REGS
                   @;ARE PRESERVED. ON RETURN  Z FLAG SET TO 1 AND
                   @;CARRY CLEARED.
                   @;ASSUMES  REG A NOT 00 ON ENTERING.
                   @;
0366    2B         @HYDCR:    DCX     H         ;DCR HIGH BYTE
0367    35         @          DCR     M         ;
0368    23         @          INX     H         ;RESTORE HL
0369    B7         @          ORA     A         ;SET Z=1
036A    C9         @          RET               ;
                   @;
                   @;
                   @;
                   @;*****************************************
                   @;
                   @;ESTART: SAVES REG HL ON STACK AND THEN JUMPS
                   @;TO PRGM.  THE USER PRGM SHOULD PRESERVE IX
                   @;AND IY REGS AND RETURN TO THE "PROCESSOR"
                   @;BY <POP H   ;    RET   >
                   @;
036B    E5         @ESTART:   PUSH    H         ;SAVE REGS
036C    23         @          INX     H         ;GET LOW BYTE ADDR
036D    5E         @          MOV     E,M       ;LOAD JMP ADDR
036E    23         @          INX     H         ;INTO DE
036F    56         @          MOV     D,M       ;
```

Listing 1 continued on page 416

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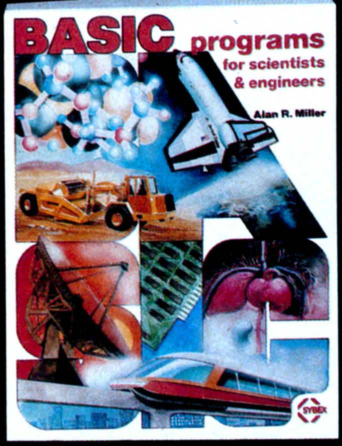

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Data-Base Management Systems: Powerful Newcomers to Microcomputers

Michael Gagle and Gary J Koehler
Micro Data Base Systems Inc
POB 248
Lafayette IN 47902

Andrew Whinston
Krannert Graduate School of Management
Purdue University
Lafayette IN 47907

Large computers are already running many successful applications programs developed by using commercial data-base management system (DBMS) packages. DBMS packages for large computers sell in the $50,000 to $200,000 range and require approximately 50 K words of memory. As a result, it is impractical to apply the development concepts used on large machines to data-base management systems for the microcomputer. A more promising approach is to create a DBMS offering the best features of systems for larger computers, yet fitting the microcomputer's capabilities. Two of the authors of this article, Gary Koehler and Mike Gagle, work for Micro Data Base Systems, Inc, and have participated in the development of a data-base management system tailored to the microcomputer. Called MDBS.DMS, this data-base management package serves as the basis of most of the discussion that follows. But first we'll explain the basic concepts and terms of data-base management systems.

Data-Base Concepts and Terms

The central concept of data-base management is to create files that can be linked from different points of view. By using different linkages, the user can generate different kinds of reports based on the same data files. The DBMS makes this possible by handling all the details of data storage. When using the DBMS, the user never refers to physical storage locations, but deals instead with the conceptual structure of the data.

Many of the concepts used in commercial data-base systems were defined by CODASYL (Conference on Data Systems Languages). A brief description of important concepts from the CODASYL report of April 1971 will help you follow the rest of this article:

Data item: A unit of data that can take on a range of values. Examples of data items are customer names, part numbers, and selling prices. Each data item may have a name assigned to it.
Record type: A collection of zero or more data items. An example of a record type is the collection of the data items customer name, address, city, and zip code. The user can give a record type a name (such as CUSTOMER, for our example). A data-base record corresponds to a logical record in programming languages such as Pascal.
Record occurrence: A record type such as CUSTOMER can have many occurrences in the data base, one occurrence for each customer. The values of the data items in each record occurrence reflect the appropriate values for the corresponding customer.
Set-type: As data items can be grouped into records, records can be linked into sets. Sets in the CODASYL sense do not correspond to mathematical sets, but rather to an ordered grouping of related records. Usually, a set consists of one record occurrence (referred to as an OWNER) that has several occurrences of some other record type (MEMBERS) associated with it. Consider again the case in which a supplier could supply various parts. A set relation could be defined between the supplier record type and the parts record type linking a supplier with different parts supplied.

In the CODASYL specifications, sets are said to be "one-to-many" sets. Any member record occurrence (such as a part) can be associated with only one owner

← Circle 22 on inquiry card.

record occurrence (such as a supplier) through a given set-type. If several suppliers can supply the same part, there exists between supplier and part a "many-to-many" relationship. Some DBMS (such as MDBS.DMS) explicitly allow many-to-many relationships, while others can support such relationships only by creating a dummy record, called a "nub" or "link" record.

Features of Data-Base Systems

Data-base management systems offer many attractive features, including: multiple views of data, data-base flexibility, nonredundancy of data, security of data, self-description of data bases, query processing, and interfacing with a host language.

Sequential file organization is adequate for some programming purposes. Sequential files assume that all data in a file will be processed in a certain order. The ISAM (indexed sequential-access method) helps meet the need to access a particular sequential record by reference to an index or key.

For simple data structures, an ISAM-type organization works well enough. But as the interrelationships of the data become more complex, even simple reports and routine updating of data require more file handling. Furthermore, simple data structures quickly become complex as users begin to appreciate the usefulness of the computer and request more applications.

A true data-base management system is specifically designed to handle complex data structures by offering multiple views of the same data; that is, a DBMS lets an applications programmer view a data structure in the way most convenient for the application at hand. Greater convenience means that the programmer spends much less time writing, debugging, and maintaining programs—enough time to offset the start-up costs of the DBMS.

Data-Base Flexibility

It's common to hear someone say, "Now that we have our inventory system computerized, it sure would be nice to have a report on ______." The blank can be filled with almost anything from "delivery times from all suppliers in Kansas" to "average inventory level of parts that cost more than $10 each." Sometimes hindsight shows you should have included in the system some data (say a reorder point) not defined in the original data base. That's why DBMS should include the ability to add or delete types of data in the data base. Of course, changing the data-base structure often requires updating the data occurrences. If the DBMS can do this updating, the process of changing the data structure is straightforward.

In the absence of a restructuring feature, the typical user defines extra item fields for "future use" or else rebuilds the data base. The first alternative is wasteful and doesn't allow for adding or deleting record types or set relationships. The second alternative is painful to say the least.

Nonredundancy of Data

Often, one piece of information (say a supplier's name) appears in several different data files. If the supplier incorporates and changes its name, updating requires finding the old name in *each* of the data files and then making the change in each case. Further, if a file is sorted by names, the file may have to be re-sorted.

If the name of the supplier occurs only in *one* place, updating is simple. And so it is in a data base with an appropriately organized structure. The data-base system automatically performs any data reorganization necessary to maintain sorted orders. The nonredundancy feature also reduces problems caused by inconsistent data.

Security of Data

There are a variety of ways to protect the privacy and integrity of data in a data base. These include sophisticated authorization checks and password validation. The security mechanisms of the MDBS.DMS data-base management system will serve as an example.

When the user defines data to the MDBS.DMS system, the user gives each piece of information separate read- and write-access levels. Additionally, the system provides that each user may be declared and given unique read- and write-access permission and an access password. When the data base is used, the DBMS prohibits persons from reading or writing data unless their access level permits it. A clerk may be restricted to reading the

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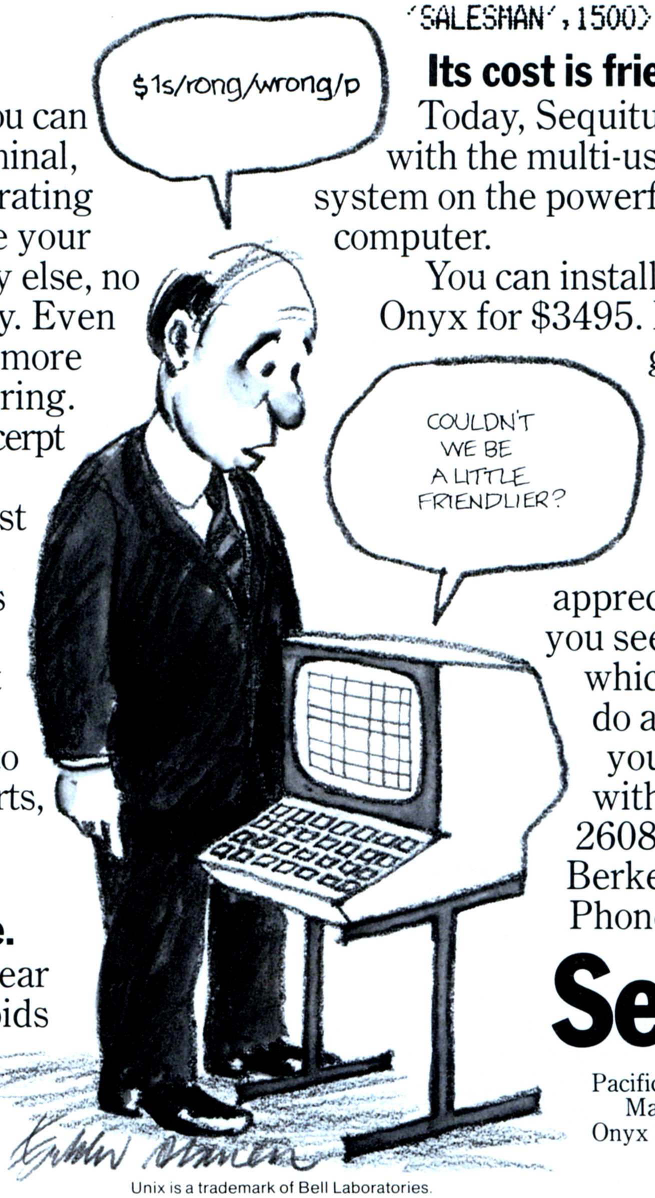
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price of an item, while a manager can change the price. The system also includes precautions that make it difficult to *infer* information about data in the system.

Self-Description of Data Bases

An integral part of a data base is its *data directory*, which contains information about each type of data defined in the data base. This information includes the name of the data item, the data type (in the larger sense, eg: CHARACTER, REAL, INTEGER), the length of the data item, and its read/write access levels. Data items are grouped into named records, and records may be organized by sets. Thus, the data directory keeps information on the records (including the data items in the record and the read/write access levels of the record itself), and the sets (including the ordering of the set of records and the records allowed in the set).

The data directory contains all the information needed for the DBMS to maintain the data base. However, the presence of the data directory implies that generalized programs can be developed that are independent of any particular data base. These programs can extract information from the data directory and, based on this information, process the data in the data base. There are essentially two types of programs: a broad class written in a host language such as BASIC, and a generalized report writer or query processor.

Query Processing

A query system consists of programs that can add, retrieve, update, and display data from a data base. A query system is flexible in that it is not restricted to a particular data base or data structure, but will work with a wide variety of data bases. Query systems are usually intended for nonspecialists who wish to use a data base or programmers who wish to perform initial checkouts of program logic. Most query systems can be used to generate reports from data in the data base, and the more sophisticated query systems allow great flexibility in use.

Examples of query language statements might be:

- LIST CUSTOMER NAME, ADDRESS FOR STATE = 'OHIO'
- CHANGE UNIT-PRICE TO 0.75 FOR PART.NUMBER = 056127

Interface with a Host Language

Most data-base systems can be accessed by "host-language" programs. In microcomputers, this is generally done by a call to a subroutine that contains the DBMS code, which is written in machine language for optimal processing speed. Typical capabilities include:

- Create: Create an occurrence of a data record.
- Store: Store data in the data base.
- Fetch: Retrieve data from the data base.
- Insert: Put a data record in a data relationship.
- Modify: Change data in a data record.

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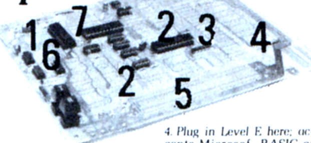

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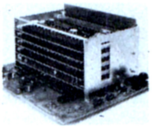

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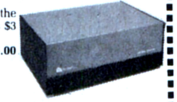

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- Find: Locate a data occurrence.
- Delete: Delete a data record.
- Remove: Remove a data record from a set.

The data base may also be accessed by query systems, as mentioned previously.

Program Example

In order to explain the advantages of using a DBMS in a microcomputer environment, we will present an example using the fictitious Nibble Computer Store. This store retails components and equipment supplied by many vendors. One of the store's major concerns is to keep customers satisfied by providing speedy service. The store maintains an inventory-order system with a tracking of customer orders.

Handling this management problem requires the following reports:

Report 1: A list of customers (sorted by name) who have placed an order within the last sixty days.
Report 2: A list of parts that need to be reordered.
Report 3: A list of customers whose orders have been outstanding for more than two days. Also, a list of the parts (and the name of the suppliers of those parts) that are holding up those orders.

The data requirements are as follows:

Requirement 1: Maintain a list of customers, sorted by name *and* by customer number.
Requirement 2: Maintain a list of suppliers, sorted by name *and* by supplier number.
Requirement 3: Maintain a list of parts stocked, sorted by description *and* by part number.
Requirement 4: Keep track of which parts are supplied by each manufacturer.
Requirement 5: Keep track of the status of each customer's orders.

We first show a possible (although simplistic) way to implement such a system using conventional file-management techniques.

A Conventional Approach

Although there are many ways to design a system to perform the functions needed by the Nibble Computer Store, most suitable systems would require creating and maintaining a file for each particular application. Table 1 shows several types of files that might be required.

A look at the five data requirements shows why so many files are needed. Consider requirement 1. A file of customer data can be sorted either by name or number. But to sort the file by both name and number usually requires that a copy of the file be made first. Then the original file can be sorted by customer name, and the

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File 1	File 2	File 3
(Sorted by Customer Name)	(Sorted by Customer Number)	(Sorted by Supplier Name)
Customer Name	Customer Name	Supplier Name
Customer Number	Customer Number	Supplier Number
Street	Street	Street
City	City	City
State	State	State
Zip Code	Zip Code	Zip Code

File 4	File 5	File 6
(Sorted by Supplier Number)	(Sorted by Part Number)	(Sorted by Part Description)
Supplier Name	Part Number	Part Number
Supplier Number	Part Description	Part Description
Street	Selling Price	Selling Price
City	Quantity in Inventory	Quantity in Inventory
State	Reorder Point	Reorder Point
Zip Code		

File 7	File 8	File 9
(Sorted by Part Number)	(Sorted by Date Received)	(Sorted by Order Number)
Part Number	Order Number	Order Number
Supplier Number	Customer Number	Part Number
	Date Received	Quantity Ordered
	Date Shipped	

Table 1: *The types of files needed to handle the data-processing tasks of the Nibble Computer Store without using a data-base management system. Since different tasks require different views of the data, the programmer must maintain files sorted appropriately for each task.*

copy file by customer number. So data requirement 1 gives us files 1 and 2.

The same problem of double sorts applies to data requirements 2 (suppliers) and 3 (parts). This gives us six files.

The easiest way to keep track of which parts are supplied by which supplier (data requirement 4) is to define a file containing the part numbers for each supplier (file 7).

Data requirement 5 is to keep track of each customer's orders. Several approaches are possible, but we'll handle the task by creating an order file (file 8).

Turning now to the required reports, report 1 is a list of customers who have placed an order in the last sixty days. The report can be made by scanning file 8 (orders sorted by date) for orders falling in the sixty-day period, and then writing the corresponding customer numbers on a file. That file can then be sorted and used to extract the names of customers from file 1. Then the names extracted can be listed in still another file.

A list of parts to be reordered (report 2) is trickier. The parts-on-order file (file 9) can be scanned, and then the quantity ordered for unfilled orders can be written on a scratch file. This file can then be sorted on the part number, and the quantity on order can be summed for each part. This quantity can then be compared to the number of parts in inventory and the reorder points (file 5) to show which parts must be reordered.

The conventional approach could generate report 3 in two phases. First, the orders sorted by date (file 8) can be scanned to find orders that have been outstanding for more than two days. The customer numbers can then be written on a file, sorted, and used to extract the customers' names from file 1. A similar process will find the parts whose order quantity is larger than the quantity on hand, giving the suppliers' names.

Four other files would also be required. Files 3 and 4 maintain supplier information (with two different sort orders). File 6 maintains parts information and file 7 gives the correspondence between suppliers and parts.

Obviously, writing the needed programs and maintaining these data files would be tedious, even though this is a *simple* example, with other complicating factors left out. If additional requirements are placed on the system (such as a listing of suppliers that supply parts that sell for less than $2), more programs have to be written. We also have a problem with redundant data—if a customer's address changes, we have to update two files. Even worse, if a customer's *name* changes, one of the files has to be completely re-sorted.

The primary problem here is that different applications require different "views" of the data. For some applications, having the order information embedded in the customer file would be best. But for other applications, the order data might need to be closely limited to the supplier file. The result is that the compromise solution of figure 1 is developed, with corresponding programming complexity.

The Data-Base Management System Approach

Figure 1 shows a data structure that could be used to represent the information needed for the inventory-order

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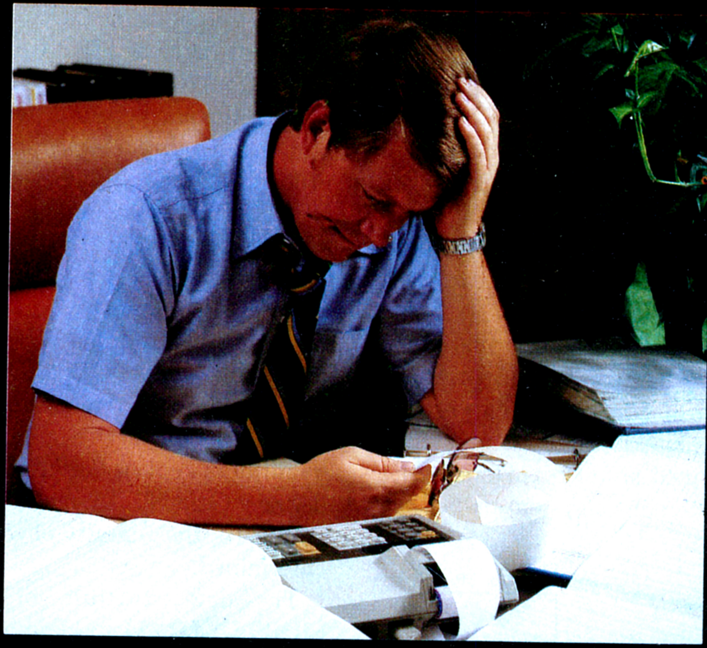

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system. The boxes represent record types (corresponding to customers, suppliers, parts, orders, and order quantities). The names within boxes correspond to *data* items, the basic units of data that form the records. Finally, four *set-types* are defined. Sets are used to associate records. For example, SET3 is used to associate parts with their suppliers. Since, in our simple system, each part is supplied by only one supplier, we say that the supplier "owns" parts, in accordance with the data-base terminology of *set owners* and *members*. Figure 2 shows two suppliers and the parts they supply.

Information in a data base is accessed by "traversing set occurrences." To find out what parts Acme Computer supplies, we look at the occurrence of SET3, which has Acme Computer as an owner, and examine each member of the set. This allows us to retrieve data about each part supplied by Acme.

Since sets are used to access data-base information, it follows that some sets must be defined that allow the user to "get his foot in the door" of the data base. This is done with sets having a record named "SYSTEM" as their owner. Such sets can be defined so all occurrences of a record can be accessed by traversing a system-owned set.

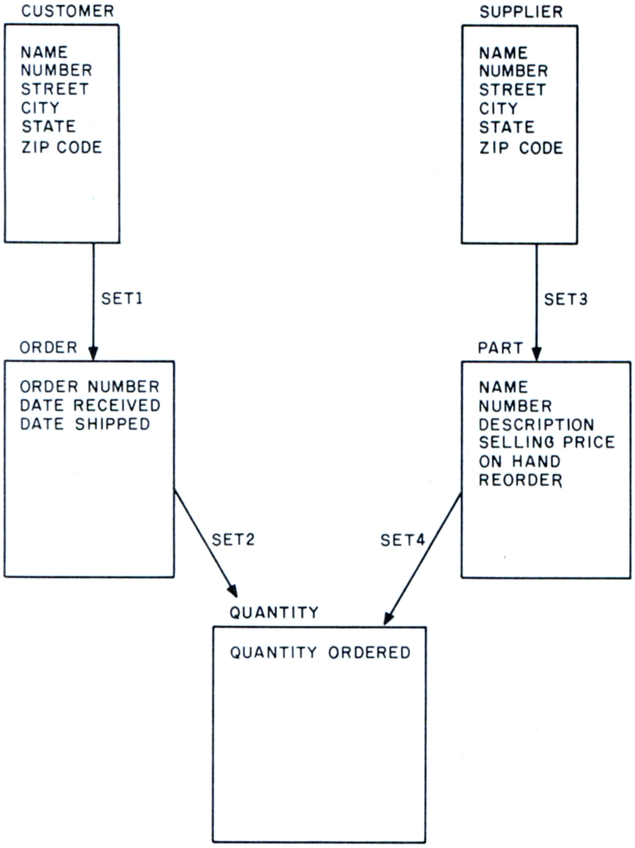

Figure 1: *A data structure representing the information needed to handle the data-processing tasks of the Nibble Computer Store. The boxes represent record types. The names within boxes correspond to the data items that make up the records. The lines between boxes represent set-types—ordered groupings of related records. SET3, for example, associates parts with their suppliers.*

One more thing about sets: since the members of a set occurrence are accessed one at a time as we traverse the set, we can put an ordering on the set. We can define the set to be ordered on, say, Supplier Name, and the DBMS will automatically maintain the records in the set in sorted order. If we define a different set ordered on Supplier Number, we can access the records in either order simply by choosing the appropriate set. Additional set orderings, such as FIFO (first in, first out) or LIFO (last in, first out), are also supported.

With this background, we can discuss the structure of figure 1. Each customer can have zero, one, or more orders in our system, and SET1 is defined with CUSTOMER as owner and ORDER as member. The relationship between orders and parts is less clear. Each order is made up of one or more parts, but each part can appear in more than one order. Also, the problem arises of where to put the quantity ordered of each part. If we put the quantity in the ORDER record, we don't know which part the quantity refers to (since the order can consist of more than one part). Similarly, an ambiguity exists if the quantity is kept in the PARTS record. The solution is to define a QUANTITY record. By appropriate use of SET2 and SET4, the quantity of each part for each order can be determined.

The data structure of figure 1 as described in MDBS.DDL, a Data Definition Language of Micro Data Base Systems, Inc, is as shown in listing 1 (see page 110). The data definition for our example is relatively straightforward. The sets such as CUSTNAME and CUSTNUM allow us to access the customer records sorted by either name or number.

Several points should be made about the DDL description in listing 1. Five users have been defined, one for each functional area of the company. The first user name, STOCKROOM, is followed by read and write authorization levels and the user's password (317-54-7674). A user may process data that has an access level equal to or less than his own. For example, the stockroom user can read supplier information, but isn't allowed to alter it since the stockroom has a write-access level of 10, while all supplier information has a write-access level of 50. The access levels were defined by:

Level 1: Stockroom/Inventory Control—This department must be able to read part numbers, part descriptions, quantity on hand, and reorder point for inventory control purposes. It must also be able to read supplier information for reorder purposes, determine quantity ordered for each part, and update quantity on hand of each part as it is put into inventory.

Level 2: Shipping—This department must be able to read parts information, customer names and addresses, and order information. It must also be able to update shipping date and quantity on hand for each part shipped.

Level 3: Order Processing—This department must be able to enter new orders.

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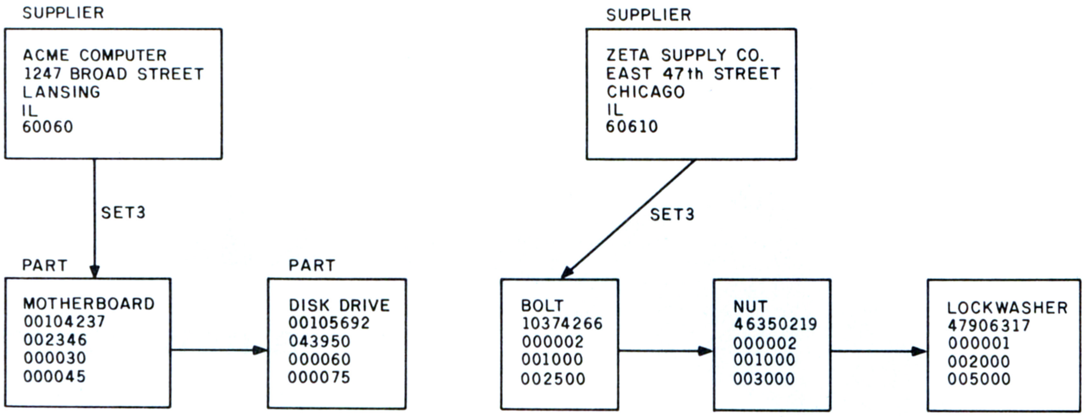
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Figure 2: *Two of the Nibble Computer Store's suppliers and the parts they supply. This figure gives more detail on SET3 of figure 1.*

Level 4: New Accounts—This department must be able to add new customers to the customer list and update customer information.

Level 5: Purchasing—This department must be able to add new supplies to supplier list and update supplier information. It must also be able to define new parts and alter prices of parts and the supplier-parts relationships.

We are now ready to generate the reports listed in table 1. To simplify matters, we will not be concerned with loading data into the data bases or updating information. Out of the repertoire of DML (Data Management Language) commands in MDBS.DMS, we will use:

FFM: Find First Member—Insures that the first record in a set occurrence is available for processing.

FNM: Find Next Member—This command actually traverses the set occurrence, moving from one record to the next each time it is called.

SOM: Set Owner based on Member—Indicates that the record that is the "current" member of one set should be treated as the owner of some other set.

SMM: Set Member based on Member—Indicates that the "current" member of one set-type is also the current member of some other set.

GFM: Get Field from Member—Retrieves data from a named field (item) in the "current" member of a set.

In MDBS.DMS, all routines return a value that gives a status indication. Frequently, a nonzero status value represents an error condition. MDBS.DMS can be called from several languages running under CP/M and from disk-based Radio Shack, Apple, and North Star systems. The status value is returned to a user-defined variable. For example, in modified North Star BASIC (see reference 1), a call to FFM looks like:

E0 = CALL (*addr*, "FFM, SET3")

Here, *addr* is the address of the MDBS.DMS software. Two entry points to MDBS.DMS are required: one for defining blocks and one for the DMS routines.

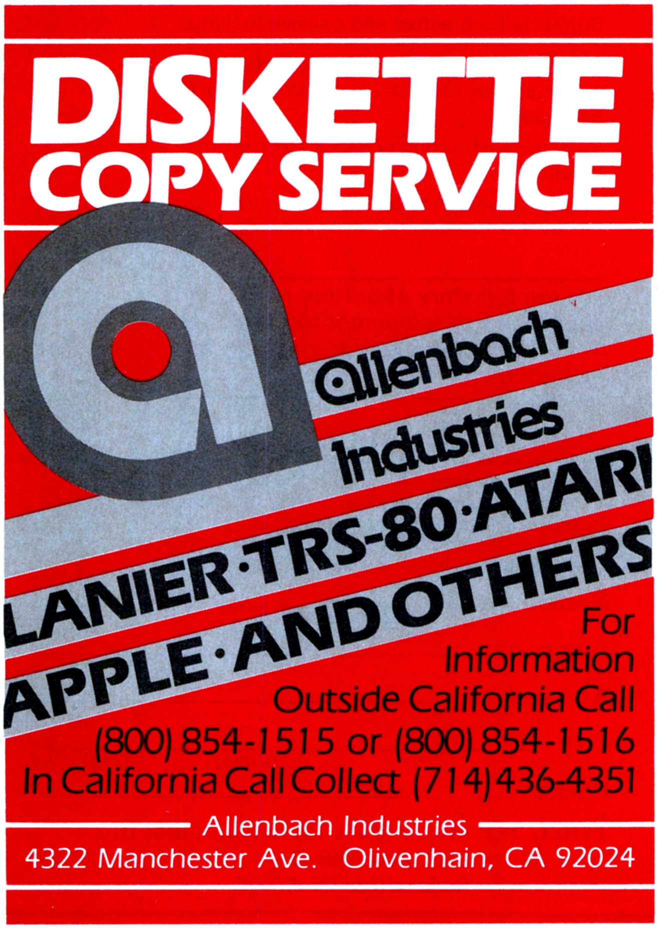
The BASIC user of MDBS.DMS can define named data blocks (similar to the sub-schema of the CODASYL committee report). For example, the user may want to define a block called PARTDATA made up of the BASIC variables:

N	for part number
D$	for part description
P	for price
O	for on-hand quantity
R	for reorder point

So to insert data into the data base, the user issues the call:

E0 = CALL (*addr*, "CRS, PART, PARTDATA")

Text continued on page 120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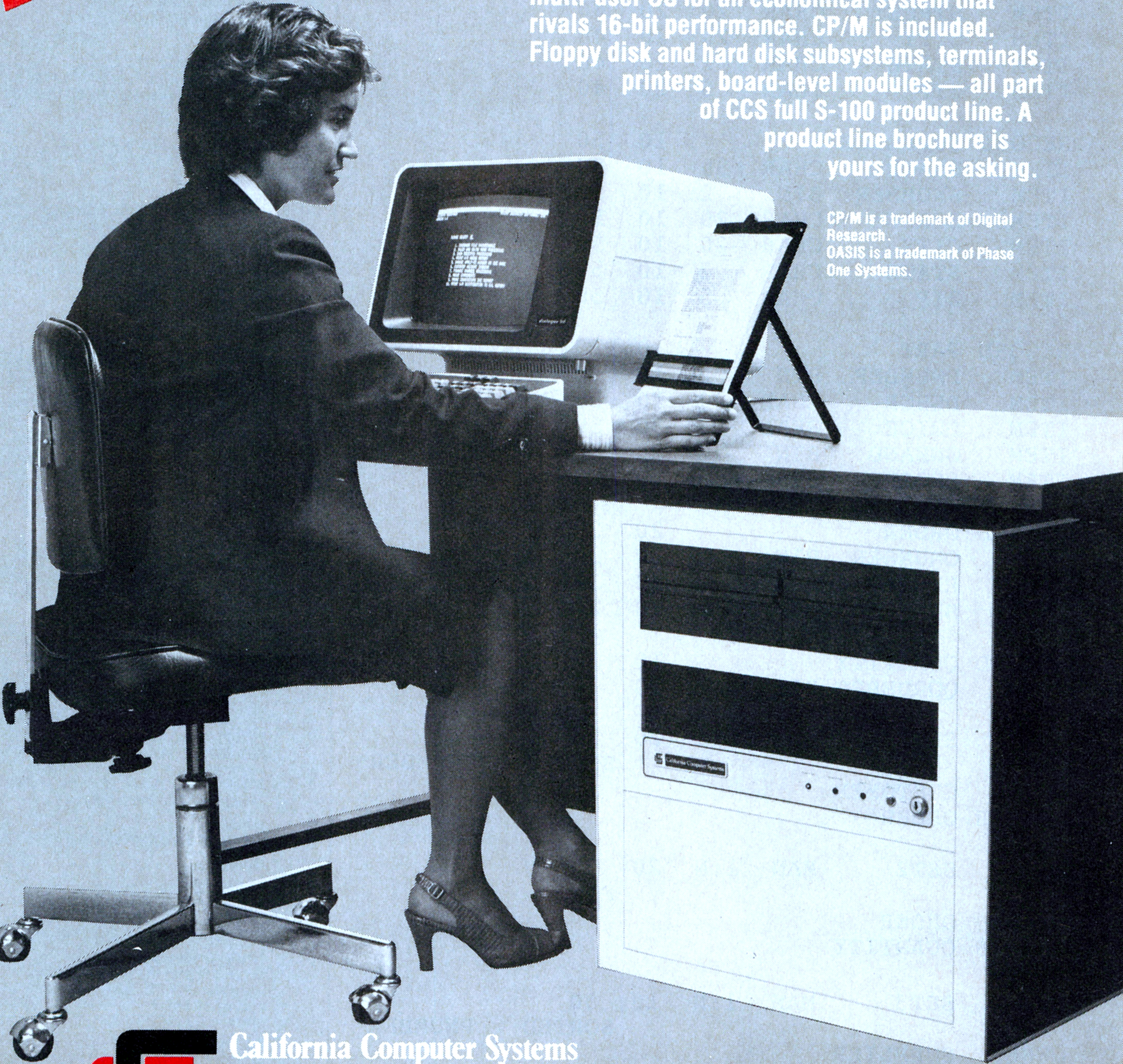

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MAKING MINIS OUT OF MICROS.

Listing 1: *A description in MDBS.DDL (Data Definition Language) of a data structure meeting the needs of the fictitious Nibble Computer Store. This description corresponds to the data structure shown in figure 1.*

```
PASSWORDS
       STOCKROOM          10  10   317-54-7674
       SHIPPING           20  20   SECRET
       ORDER PROCESSING   30  30   MAILROOM
       NEW ACCOUNTS       20  40   IGLOO
       PURCHASING         30  50   317-742-7388

RECORD CUSTOMER           20  30
ITEM   CNAME    CHAR  30  20  40
ITEM   CNUMBER  BIN    2  20  40
ITEM   STREET   CHAR  20  20  40
ITEM   CITY     CHAR  20  20  40
ITEM   STATE    CHAR   2  20  40
ITEM   ZIP      CHAR   5  20  40

RECORD SUPPLIER           10  50
ITEM   SNAME    CHAR  30  10  50
ITEM   SNUMBER  BIN    2  10  50
ITEM   STREET   CHAR  20  10  50
ITEM   CITY     CHAR  20  10  50
ITEM   STATE    CHAR   2  10  50
ITEM   ZIP      CHAR   5  10  50

RECORD PART               10  10
ITEM   PNUMBER  BIN    2  10  50
ITEM   DESCR    CHAR  20  10  50
ITEM   PRICE    REAL   8  30  50
ITEM   ONHAND   BIN    2  10  10
ITEM   REORDER  BIN    2  10  50

RECORD ORDER              20  20
ITEM   ONUMBER  BIN    2  20  30
ITEM   RECEIVED BIN    2  20  30
ITEM   SHIPPED  BIN    2  20  20

RECORD QUANTITY           10  30
ITEM   QORDERED BIN    2  10  30

SET    SET1     MAN  1:N  20  30
                             SORTED   ONUMBER
OWNER  CUSTOMER
MEMBER ORDER

SET    SET2     MAN  1:N  20  30
                             FIFO
OWNER  ORDER
MEMBER QUANTITY

SET    SET3     MAN  1:N  10  50
                             SORTED   PNUMBER
OWNER  SUPPLIER
MEMBER PART
```

Listing 1 continued on page 112

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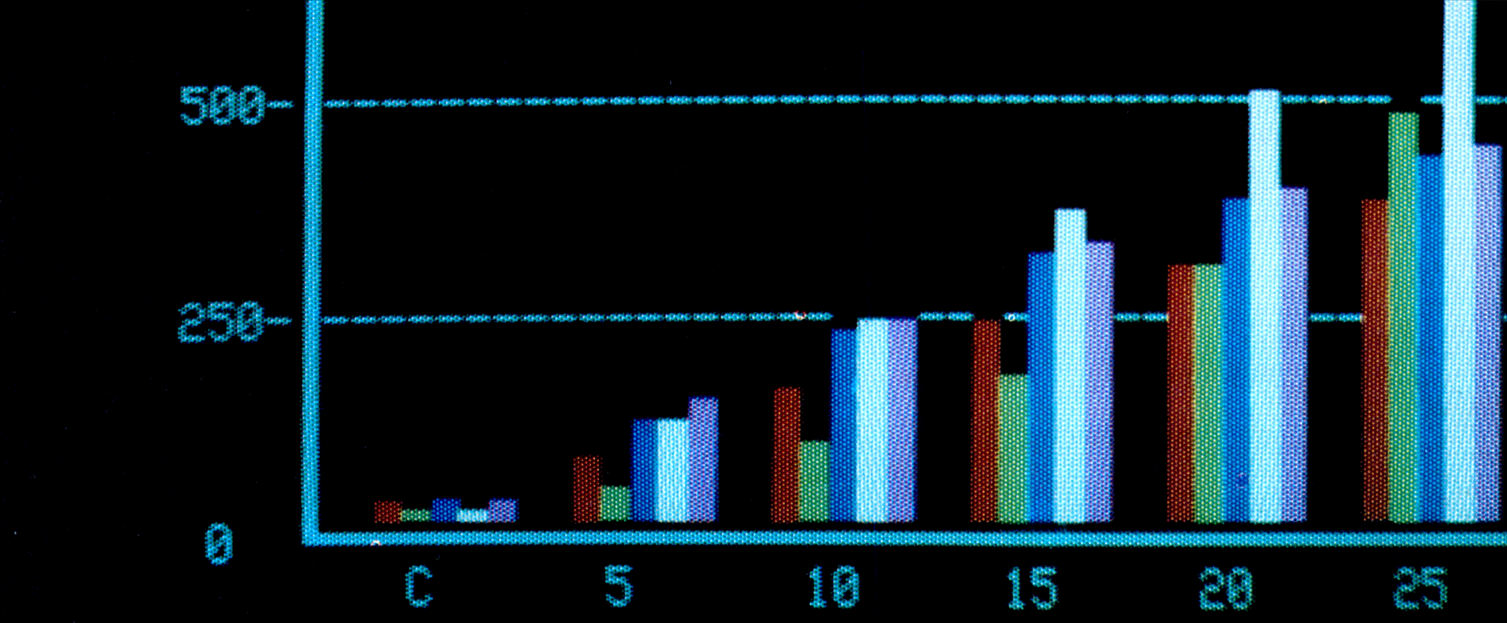

Money-back guarantee for computer professionals:

Buy factory-direct from Intelligent Systems.

It took hard work and experience for you to become a leader. Same here. Founded in 1973, we were the first company to ship 20,000 color graphics units. We sell to computer professionals—not through computer stores. So, if you don't need a salesman to tell you what you need, try this unique offer:

A factory-direct, money-back guarantee for our 3650 color graphic desktop computer with 56K of memory for only $1995—plus your choice of either an internal 5¼" 92K Floppy Mini Disk Drive for $395, or an external 8" Floppy Disk Drive for $895! (These prices good only with this offer.) You can buy only one unit before 12/31/81, cash with order. Use it for 30 days; if you're not sold on the merits of your color graphic computer, return it. We will refund the full purchase price and your only cost would be transportation charges to and from Norcross, Georgia.

Why such a dramatic offer? Intelligent Systems was built around the needs of computer professionals. We sell primarily through OEM's and want to introduce the dynamics of color graphics to professionals like yourself—so you can help us introduce color graphics in your company.

Features Included for $1995: • 56K total memory, 32K user RAM, 4K disk buffer RAM, 4K refresh RAM, 16K ROM (includes extended disk BASIC) • 13" raster scan color CRT • 8 foreground colors w/blink and 8 background colors • 64 col./32 line • 64 ASCII & 64 graphics characters • 128H x 128V graphics w/point, bar & vector generators • RS232C port • Buffered bus connector • 72 key professional keyboard • User's Manual & sampler disk • Factory Warranty: 90 days parts & labor

And Your Choice of: • Internal 5¼" 92K disk drive: $395 • External 8" 295K disk drive: $895 (These prices good only with this offer.)

Options Include: • 101 key keyboard: $100 • 117 key keyboard: $250 • blank 8K board for add-on EPROM: $75 • One-year Factory Service Contract: $350

Software Available: BASIC is standard; you can add Fortran for $75. Text editors, assemblers, other utilities available. Also, hundreds of additional programs, including ColorCalc,™ ColorGraph,™ as well as programs for education, accounting, WP, statistics, etc.

Will your information processing be more comprehensible in color graphics (or color slides) in management meetings? If so, act now. For details, call Marketing Services at 404/449-5295.

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This offer, not available through computer stores, expires 12/31/81. U.S. domestic prices.

Circle 202 on inquiry card

Listing 1 continued:

```
SET     SET4      MAN  1:N  10  30
                                IMMAT
OWNER   PART
MEMBER  QUANTITY

SET     CUSTNAME  AUTO 1:N  20  40
                                SORTED   CNAME
OWNER   SYSTEM
MEMBER  CUSTOMER

SET     CUSTNUM   AUTO 1:N  20  40
                                SORTED   CNUMBER
OWNER   SYSTEM
MEMBER  CUSTOMER

SET     SUPLNAME  AUTO 1:N  10  50
                                SORTED   SNAME
OWNER   SYSTEM
MEMBER  SUPPLIER

SET     SUPLNUM   AUTO 1:N  10  50
                                SORTED   SNUMBER
OWNER   SYSTEM
MEMBER  SUPPLIER

SET     PARTDESC  AUTO 1:N  10  50
                                SORTED   DESCR
OWNER   SYSTEM
MEMBER  PART

SET     PARTNUM   AUTO 1:N  10  50
                                SORTED   PNUMBER
OWNER   SYSTEM
MEMBER  PART

SET     ORDERS    AUTO 1:N  20  30
                                SORTED   RECEIVED
OWNER   SYSTEM
MEMBER  ORDER
```

Listing 2: *A program segment opening a data base using the data-base system MDBS.DMS. Brackets are used to pass addresses of variables; the right bracket has been translated to a parenthesis by North Star BASIC. Lines 1390 through 1470 represent portions of the program not given here.*

```
1000 REM ************************************************************
1010 REM **
1020 REM ** User's name and password **
1030      DIM N$(16) , P$(12)
1040 REM **
1050 REM ** Input user's name **
1060      INPUT "NAME? " , N$
1070      PRINT
1080 REM **
1090 REM ** Now the password -- but no echo **
```

Listing 2 continued on page 114

MORROW DE NS

NOW, 26 Mbytes
$4,495

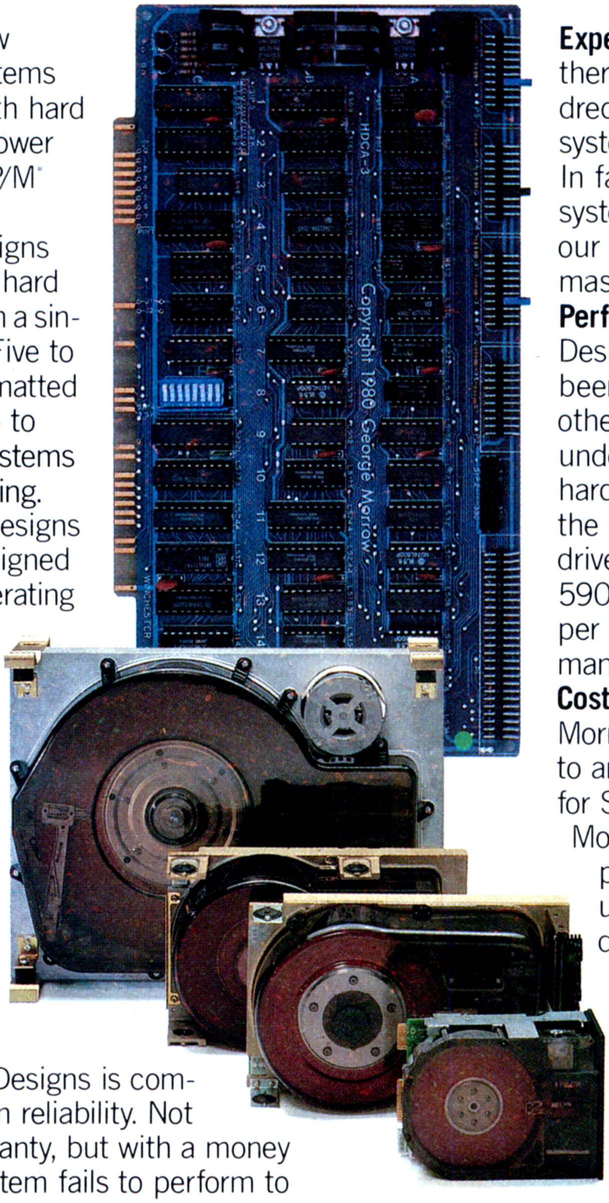
Leading edge technology in hard disk systems.

Complete systems. Morrow Designs hard disk subsystems are delivered complete with hard disk, controller, cabinet, power supply, fan, cables and CP/M* 2.2 operating system.

Widest range. Morrow Designs offers the widest range of hard disk systems available from a single supplier. 5¼," 8," 14." Five to over 100 megabytes of formatted hard disk storage. $2,995 to $17,980. Cost effective systems that work. And keep working.

S-100 and more. Morrow Designs hard disk systems are designed for use with the CP/M operating system. Available software packages allow our systems to run on any IEEE696/S-100 Standard system with no hardware modification. Plus, Cromemco,*** North Star,** Vector Graphics, Godbout, Dynabyte, Exidy,**** IMSAI, Micromation, Processor Technology and California Computer Systems.

Reliable systems. Morrow Designs is committed to hard disk system reliability. Not simply with a 90-day warranty, but with a money back guarantee. If our system fails to perform to specification, send it back. We'll send back your money.



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Cost effective answers. Compare Morrow prices and performance to anything presently available for S-100 systems. You'll find Morrow's price/megabyte/performance ratio to be unmatched. Leadership in disk systems technology earned us leadership in price/performance. And that may have earned us a call from you. Circle the Reader Service Number for our full line data sheets. Can't wait? Call us at (415) 524-2101. And yes, OEM quantity prices are available. **LOOK TO MORROW FOR ANSWERS.**

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****Exidy is a trademark of Exidy Corporation.

Circle 286 on inquiry card.

Listing 2 continued:

```
1100       PRINT "PASSWORD"
1110       T$ = INCHAR$ (0)
1120       IF ASC ( T$ ) = 13 THEN 1190
1130       P$ (1,1) = T$
1140       FOR J = 1 TO 15
1150       T$ = INCHAR$ (0)
1160       IF ASC ( T$ ) = 13 THEN 1190
1170       P$ = P$ (1,J) + T$
1180       NEXT J
1190       PRINT T$
1200 REM **
1210 REM ** Filename **
1220       F$ = "NIBBLE"
1230 REM **
1240 REM ** Allow the user to modify the data base **
1250       R$ = "MODIFY"
1260 REM **
1270 REM ** MDBS.DMS routines **
1280       A1 = 32768
1290       A2 = A1 + 3
1300 REM **
1310 REM ** Define a data block **
1320       E0 = CALL (A2, "DEFINE,OPENLIST" ,[F$),[N$),[P$),[R$),4)
1330       IF E0 <> 0 THEN 1450
1340 REM **
1350 REM ** Open the data base **
1360       E0 = CALL ( A1 ,    " OPEN , OPENLIST "   )
1370       IF E0 <> 0 THEN 1450
1380 REM **
1390 REM **********************************************************
1400 REM **
1410 REM ** ** APPLICATION PROGRAM **
1420 REM **
1430 REM **********************************************************
1440 REM **
1450 REM ** ** ERROR PROCESSING **
1460 REM **
1470 REM **********************************************************
```

Listing 3: *A BASIC program segment generating a list of customers who have placed orders at the Nibble Computer Store in the last sixty days. This listing assumes that an MDBS.DMS data base has been opened and that data blocks have been defined.*

```
1000 REM ** The following code assumes that variable D0 **
1010 REM ** has been initialized to the current Julian date **
1020 REM **
1030 REM ** MDBS.DMS addresses **
1040       A0 = 32768
1050       A1 = A0 + 3
1060 REM ** Data Block Definitions **
1070       E0 = CALL (A1,"DEFINE,RECVD",[D1),1)
1080       E0 = CALL (A1,"DEFINE,CNAME",[C$),1)
1090 REM ** Access each customer in turn **
1100       E0 = CALL (A0,"FFM,CUSTNAME")
1110       IF E0 <> 0 THEN 1350
1120 REM ** Check each of this customer's orders **
1130       E0 = CALL (A0,"SOM,SET1,CUSTNAME")
```

Listing 3 continued on page 116

Phenomenal!

STAR-EDIT

FOR CP/M

From Supersoft, a phenomenon in screen editors/word processors. Star-Edit is a completely tested, "no surprises" screen editor suitable for any text processing task, including program writing and word processing. Its features compare with the highly acclaimed "EMACS" editor. Even though Star-Edit is at least as powerful as any other screen editor, it can be learned easily and quickly by both programmers and non-programmers. Star-Edit includes:

- Multiple file editing capabilities. The user may edit several files simultaneously.
- Split screen option for viewing different files or pieces of the same file.
- The user has free and unrestricted access to all the file at any time, regardless of whether or not the file will fit in RAM. This means that the user may edit the first page, then the last page, then the first, and so on, without rereading. This is accomplished through the use of "virtual memory" residing on disk file.
- Optional "no return mode" (fill between left and right margin) allows text to be entered without the use of carriage returns.
- Complete user manual and tutorial.
- Ability to enter ANY typeable character into the file
- Includes menu driven terminal configurator with simple selection for the 16 or so most popular terminals and video boards. Also allows customization for most other terminals.

Someone familiar with an ordinary typewriter should have no trouble learning and using Star-Edit. The novice need learn only a few commands to make immediate use of the editor; the experienced user will find that Star-Edit has a complete set of text manipulation commands (nearly one hundred).

Requires: 32K CP/M system with
cursor-addressable terminal
Star-Edit: $225.00
Manual only: $ 10.00

CP/M formats: 8" soft sectored, 5" Northstar, 5" Micropolis Mod II, Vector MZ, Superbrain DD/QD, Apple II+

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SuperSoft

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Listing 3 continued:

```
1140       E0 = CALL (A0,"FFM,SET1")
1150       IF E0 <> 0 THEN 1310
1160 REM ** Retrieve date order was received **
1170 REM ** Variable D1 receives the date **
1180       E0 = CALL (A0,"GFM,SET1,RECVD")
1190 REM ** Following statement assumes that D0 and D1 are
1200 REM ** Julian dates **
1210       IF D0-D1 <= 60 THEN 1280
1220 REM ** Order is over 60 days old -- check next order **
1230       E0 = CALL (A0,"FNM,SET1")
1240       GOTO 1150
1250 REM ** Customer has placed order within last 60 days **
1260 REM ** Print customer's name **
1270 REM ** Variable C$ receives the customer name **
1280       E0 = CALL (A0,"GFM,CUSTNAME,CNAME")
1290       PRINT C$
1300 REM ** Process next customer **
1310       E0 = CALL (A0,"FNM,CUSTNAME")
1320       IF E0 = 0 THEN 1130
1330 REM ** All customers processed **
1340       E0 = CALL (A0,"CLOSE")
1350       STOP
```

Listing 4: *A BASIC program segment that determines which parts the Nibble Computer Store needs to reorder. The listing assumes that an MDBS.DMS data base has been opened and that data blocks have been defined.*

```
1000 REM ** MDBS.DMS addresses **
1010       A0 = 32768
1020       A1 = A0 + 3
1030 REM ** Data Block Definitions **
1040       E0 = CALL (A1,"DEFINE,SHIPPED",[D2),1)
1050       E0 = CALL (A1,"DEFINE,QORDERED",[N1),1)
1060       E0 = CALL (A1,"DEFINE,ONHAND",[Q1),1)
1070       E0 = CALL (A1,"DEFINE,REORDER",[Q2),1)
1080       E0 = CALL (A1,"DEFINE,PNUMBER",[P0),1)
1090       E0 = CALL (A1,"DEFINE,PNAME",[P$),1)
1100 REM ** Generate the list in part-number order **
1110       E0 = CALL (A0,"FFM,PARTNUM")
1120 REM ** Initialize to sum the quantity ordered **
1130       N=0
1140       E0 = CALL (A0,"SOM,SET4,PARTNUM")
1150       E0 = CALL (A0,"FFM,SET4")
1160 REM ** This part may not have any orders outstanding **
1170 REM ** If this is the case, E0 will be set non-zero **
1180       IF E0 <> 0 THEN 1400
1190 REM ** Locate the order corresponding to this quantity **
1200 REM ** Ignore the order if it has been filled **
1210       E0 = CALL (A0,"SMM,SET2,SET4")
1220 REM ** If a non-zero shipping date is present, the order
1230 REM ** has been filled (Shipping date is returned in D2) **
1240       E0 = CALL (A0,"GFO,SET2,SHIPPED")
1250       IF D2 <> 0 THEN 1310
1260 REM ** Order is pending -- Sum the quantity ordered **
1270 REM ** Variable N1 receives the quantity ordered **
1280       E0 = CALL (A0,"GFM,SET4,QORDERED")
1290       N = N + N1
```

Listing 4 continued on page 118

SuperSoft's Optimizing

for CP/M

The SuperSoft "C" compiler supports most of version 7 Unix standard "C". Several special and widely desired features are supported, including:

- Macro expansions via the **#define** statement.
- Include files using the **#include** statement.
- Inline assembly code is supported with the **#asm** and **#endasm**.
- The object code may be ROMed.
- Programs may be ORGed for any location.
- Completely **dynamic memory allocation** is supported, both by the compiler and in user programs. (That is, the functions 'alloc' and 'free' are provided with the compiler.)

SuperSoft "C" is a two pass compiler. The first pass of the compiler produces an intermediate code (U-code, for Universal code). Pass two contains both the translator and the optimizer. The intermediate code is optimized and assembly code is output to file.

The optimizer typically results in 40% code reduction. This means that compiled object code will run nearly as fast as that which was written in assembler.

An important feature of the compiler is that aseembly code is produced. This means that "hand optimization" of critical sections is possible. Also, the inline coder allows easy insertion of assembly language routines.

With the compiler comes the complete source code to the I/O libraries. These libraries are equal to or better than any that exist for the 8080/Z80 computer system. Functions included:

open	close	read	write
seek	tell	fopen	create
putc	getc	flush	

The Seek command supports absolute, relative from front, and relative from end of file. Fopen includes fcreat. Also included with the compiler are numerous sample programs and a complete library of useful functions.

Compile time options include listing file, console output, syntax checking and others.

Requires: 48K CP/M, (more recommended)

"C" compiler:	$200.00
Manual only:	$ 20.00
Z8000 cross-compiler: (CP/M to Z8000 code, requires Z8000 assembler)	$500.00
Source code for in-house use only:	$5,000.00

CP/M Formats: 8" soft sectored, 5" Northstar, 5" Micropolis Mod II, Vector MZ, Superbrain DD/QD Apple II +

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Listing 4 continued:

```
1300 REM ** Process the next order for this part **
1310      E0 = CALL (A0,"FNM,SET4")
1320      IF E0 <> 0 THEN 1210
1330 REM **
1340 REM ** Pending order quantities have been determined **
1350 REM ** Check to see if quantity on hand less quantity
1360 REM ** ordered is less than the reorder point
1370 REM **
1380 REM ** Variable Q1 receives the quantity on hand **
1390 REM ** Variable Q2 receives the reorder point **
1400      E0 = CALL(A0,"GFM,PARTNUM,ONHAND")
1410      E0 = CALL (A0,"GFM,PARTNUM,REORDER")
1420      IF Q1-N > Q2 THEN 1490
1430 REM ** Part needs to be reordered **
1440 REM ** Retrieve part name (P$) and part number (P0) **
1450      E0 = CALL (A0,"GFM,PARTNUM,PNUMBER")
1460      E0 = CALL (A0,"GFM,PARTNUM,PNAME")
1470      PRINT "REORDER PART#",P0,P$
1480 REM ** Process next part **
1490      E0 = CALL (A0,"FNM,PARTNUM")
1500      IF E0 = 0 THEN 1130
1510      E0 = CALL (A0, CLOSE")
1520      STOP
```

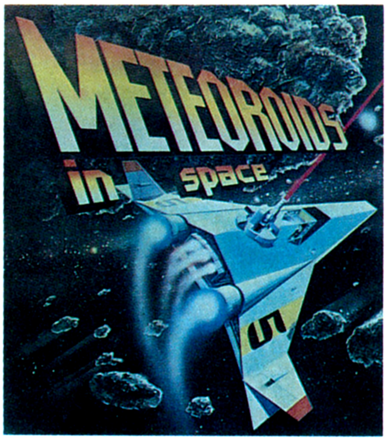
Listing 5: *A BASIC program segment that produces a report on overdue orders placed at the Nibble Computer Store. The listing assumes that an MDBS.DMS data base has been opened and that data blocks have been defined.*

```
1000 REM ** MDBS.DMS addresses **
1010      A0 = 32768
1020      A1 = A0 + 3
1030 REM ** Data Block Definitions **
1040      E0 = CALL (A1,"DEFINE,SHIPPED",[D1),1)
1050      E0 = CALL (A1,"DEFINE,RECVD",[D2),1)
1060      E0 = CALL (A1,"DEFINE,ONUMBER",[O1),1)
1070      E0 = CALL (A1,"DEFINE,CNAME",[C$),1)
1080      E0 = CALL (A1,"DEFINE,CNUMBER",[C0),1)
1090      E0 = CALL (A1,"DEFINE,QORDERED",[Q1),1)
1100      E0 = CALL (A1,"DEFINE,ONHAND",[N1),1)
1110      E0 = CALL (A1,"DEFINE,PNUMBER",[P0),1)
1120      E0 = CALL (A1,"DEFINE,SNAME",[S$),1)
1130 REM ** Find an order which has been outstanding for more
1140 REM ** than two days **
1150      E0 = CALL (A0,"FFM,ORDERS")
1160      IF E0 <> 0 THEN 1560
1170      E0 = CALL (A0,"GFM,ORDERS,SHIPPED")
1180 REM ** Ignore orders which have already been shipped **
1190      IF D2 <> 0 THEN 1530
1200 REM ** Check to see if this order is over two days old **
1210      E0 = CALL (A0,"GFM,ORDERS,RECVD")
1220      IF D0-D1 <= 2 THEN 1530
1230 REM ** An 'old' order has been found **
1240 REM ** Print customer name, customer number and order number
1250 REM ** Variable O1 receives the order number **
1260      E0 = CALL (A0,"GFM,ORDERS,ONUMBER")
1270 REM ** Locate customer data -- number (C0) and name (C$)
1280      E0 = CALL (A0,"SMM,SET1,ORDERS")
```

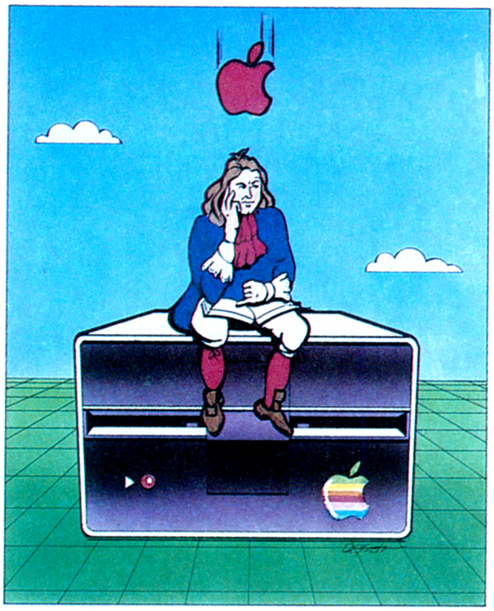
Listing 5 continued on page 120

Circle 354 on inquiry card. ⟶

our first name is Quality

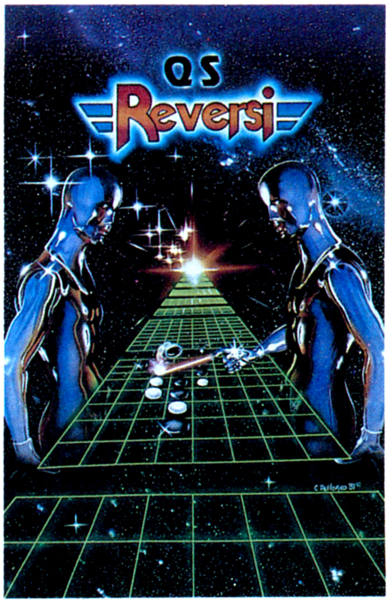


Our popular space game, *Asteroids in Space,* is now *Meteoroids in Space,* with hyperspace, autobrake, and autofire. This exciting arcade game can be played with or without game paddles. Diskette $19.95.



Beneath Apple DOS

This best-selling 170 page technical manual tells you everything you want to know about Apple's Disk Operating System. Book $19.95.



Beginners and experts both enjoy this Othello* playing game that outplays Hayden's *Reversal*. Yet *QS Reversi* has features that *Reversal* doesn't have and costs less. Diskette $29.95.

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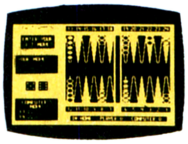
Links and relocates assembled machine language programs. Works with any assembler. Diskette $49.95.

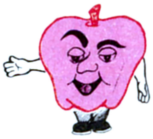


FASTGAMMON
Known for outstanding graphics and speed of play, this popular program is the standard to which other computer backgammon games are compared. Cassette $19.95. Diskette $24.95.

CR

CROSS-REF
Prints out a cross-reference of the variables in your Applesoft program. Options include changing the name of a variable. *Cross-Ref* resides passively in memory with your Applesoft program. Cassette $22.95. Diskette $24.95.

FRACAS
A fantastic adventure game like no other. Up to eight players can journey in the land of Faroph at the same time, searching for hidden treasure and fending off monsters. Cassette $19.95. Diskette $24.95.



BABBLE
This amazing and amusing program will entertain you by twisting your stories around in a most delightful way. *Babble* also works with music and sound. It's a language all its own! Cassette $19.95. Diskette $24.95.

BENEATH APPLE MANOR
The original dungeon game for the Apple computer is still one of the best. Descend into a dangerous maze of underground corridors. See if you can find the Golden Apple. Cassette $14.95. Diskette $19.95.

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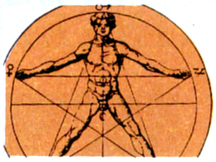

ASTROAPPLE
Your computer becomes your astrologer, generating horoscopes and forecasts based on the computed positions of the heavenly bodies. Cassette $14.95. Diskette $19.95.

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QS

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QUALITY SOFTWARE

Listing 5 continued:

```
1290      E0 = CALL (A0,"GFM,SET1,CNAME")
1300      E0 = CALL (A0,"GFM,SET1,CNUMBER")
1310      PRINT "*****",C0,C$," ORDER ",O1
1320 REM ** Determine which part(s) are holding up this order **
1330 REM **
1340 REM ** Find parts with order quantity (Q1) which exceeds **
1350 REM ** the inventory quantity (N1) for that part **
1360      E0 = CALL (A0,"SOM,SET2,ORDERS")
1370      E0 = CALL (A0,"FFM,SET2")
1380      IF E0 <> 0 THEN 1530
1390      E0 = CALL (A0,"GFM,SET2,QORDERED")
1400      E0 = CALL (A0,"SMM,SET4,SET2")
1410      E0 = CALL (A0,"GFO,SET4,ONHAND")
1420      IF N1 >= Q1 THEN 1500
1430 REM ** Offending part found **
1440 REM ** Print part number (P0) and supplier name (S$)
1450      E0 = CALL (A0,"GFO,SET4,PNUMBER")
1460      E0 = CALL (A0,"SMO,SET3,SET4")
1470      E0 = CALL (A0,"GFO,SET3,SNAME")
1480      PRINT "     PART#",P0," SUPPLIER ",S$
1490 REM ** Check next part on order (it may be overdue also) **
1500      E0 = CALL (A0,"FNM,SET2")
1510      IF E0 = 0 THEN 1390
1520 REM ** Process next order **
1530      E0 = CALL (A0,"FNM,ORDERS")
1540      IF E0 = 0 THEN 1170
1550      E0 = CALL (A0,"CLOSE")
1560      STOP
```

Text continued from page 108:

where CRS means *c*reate a *r*ecord occurrence and *s*tore data into it. This call will take the data located in the variables N, D$, P, O, and R, and store them in the data base. Retrieving data from the data base is carried out in a similar way. A BASIC variable may be used in several defined data blocks.

To open a data base using MDBS.DMS, the user can give the sequence shown in listing 2. Here, the user's name and password (read in without echoing to the console) are first entered, a call to the OPEN routine of the DMS is issued, and an error check is made. (In listing 2, the brackets are used to pass addresses of variables and the right bracket has been translated to a right parenthesis by North Star BASIC.)

Listings 3, 4, and 5 are sample programs for producing the reports discussed earlier. Each of the sample program segments assumes that the data base has been opened and that data blocks have been defined.

The program in listing 3 generates a list of customers (sorted by name) who have placed an order in the last sixty days. In line 1100, the first member of set CUSTNAME (which corresponds to the customer with the lexicographically first name) is located. The error response E0 is checked for the improbable case of no customers in

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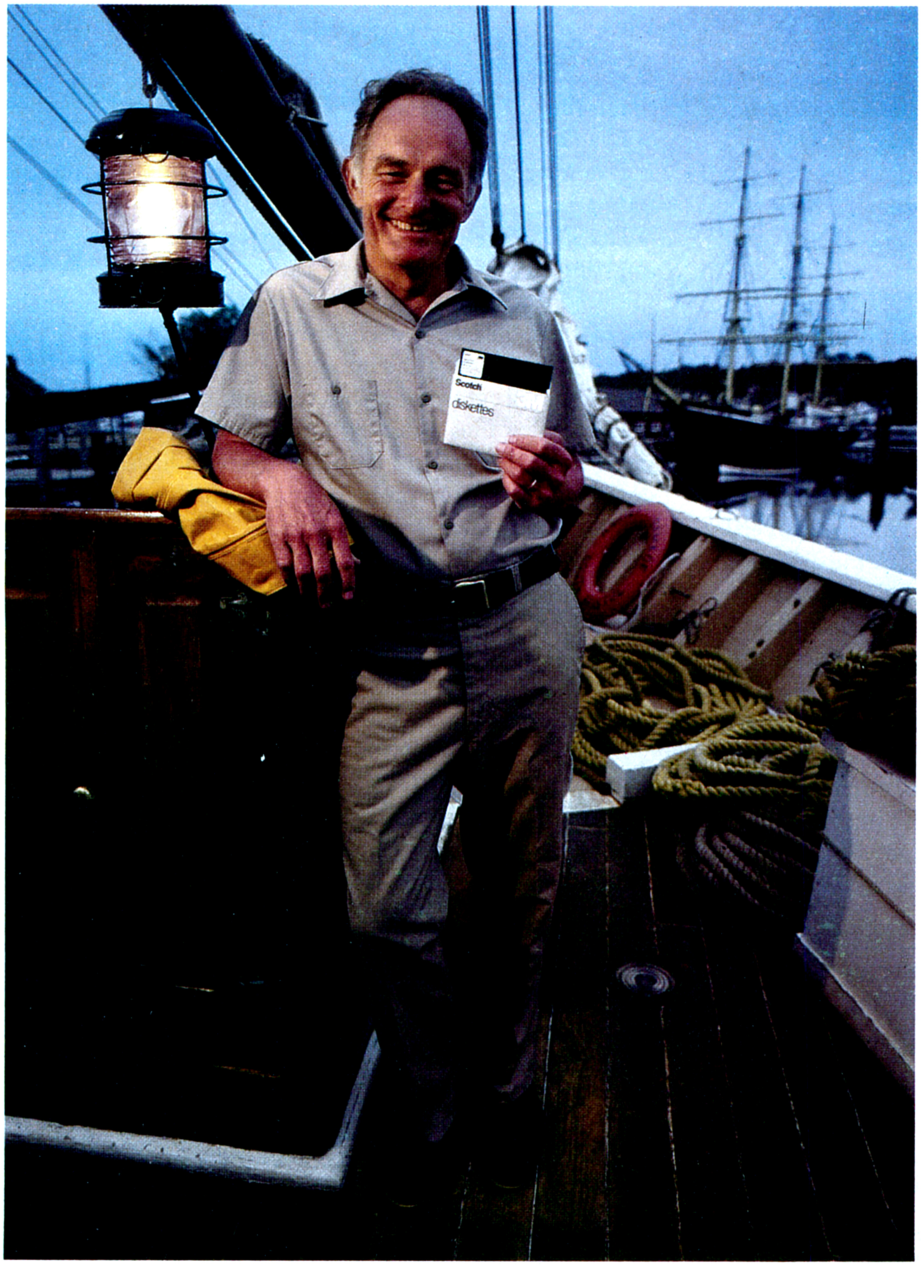

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the data base. Statements 1130 and 1140 locate the set of orders on file for the customer. The data is checked and, if the date of an order is within sixty days of the current date, the customer name is printed (statements 1280 and 1290). Statement 1310 accesses the next customer and, if we haven't reached the last customer (E0 is set nonzero when the FNM command detects end of set), the process is repeated.

A program that determines the parts that need to be reordered is shown in listing 4. A part is a candidate for reordering if the quantity in inventory less the quantity required for unfilled orders is less than some reorder point. The reorder point varies from part to part and is stored in the data base (as item REORDER in record PART).

Statement 1110 locates the first part to be processed (parts are processed in part-number order). The logic in statements 1180 through 1320 accesses the quantity ordered of the part (via SET4) for each unfilled order in the system. The inventory quantity (ONHAND) is obtained from the data base and the quantity on order for the part is used to calculate the adjusted inventory level (Q1-N). If this quantity is less than or equal to the reorder point (Q2), the number and name of the part are printed by statements 1450 through 1470. This process is repeated for all parts.

Finally, a program that produces a report on overdue orders is shown in listing 5. All orders in the system are accessed through the set named ORDERS (statements 1150 through 1160). Any order that has been shipped (indicated by a nonzero shipping date) is excluded from the report. In line 1220, the date the order was received (D1) is subtracted from the current date, and if the difference is less than three days, the order is not overdue. If the order is overdue, the customer's name and number and the order number are printed. For each part in the order, the quantity ordered (Q1) is found via set SET2 and the quantity on hand (N1) is obtained via set SET4. If the quantity ordered is greater than the quantity on hand, the part number and the number of the part's supplier are printed.

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References

1. Allen Ashley (395 Sierra Madre Villa, Pasadena CA, (213) 793-5748) has developed a patch to North Star BASIC that enables a machine-language call involving multiple parameters. Ashley's patch is available with his HDS (Hybrid Development System) package for North Star BASIC (which is part BASIC and part assembly language) or from Micro Data Base Systems with its North Star BASIC interface to MDBS.DMS.
2. Haseman, W D and A B Whinston. *Introduction to Data Management*. Homewood IL: Richard D Irwin, 1977.
3. Martin, J. *Computer Data-Base Organization*. Englewood Cliffs NJ: Prentice-Hall, 1975.

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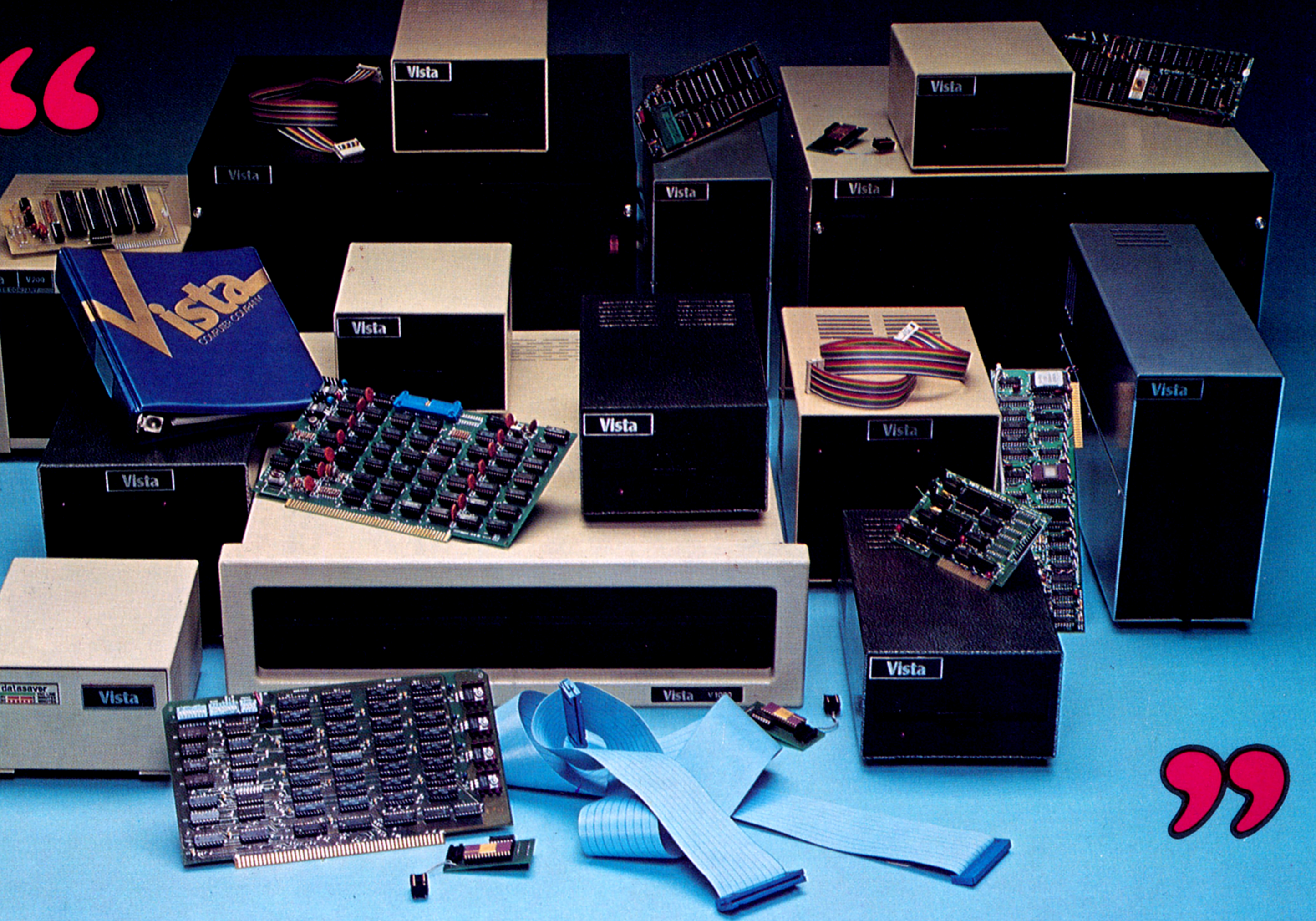

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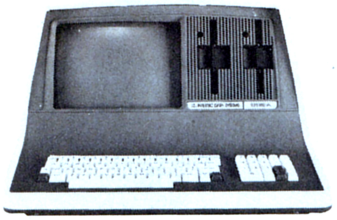

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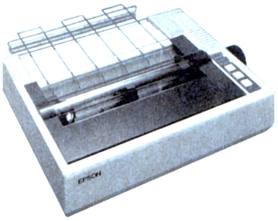

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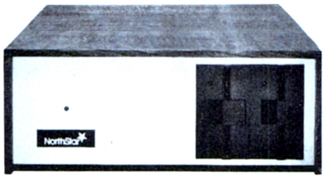

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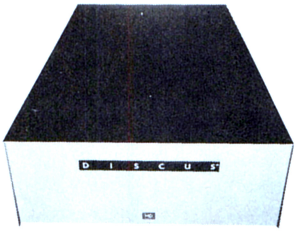

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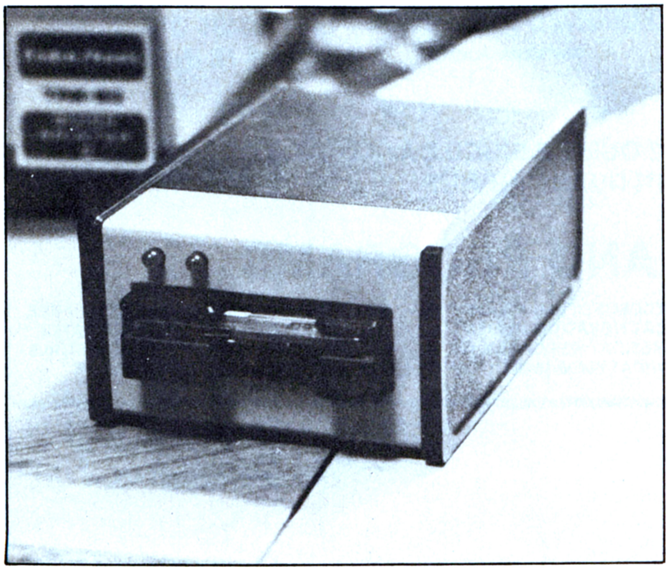

Photo 1: *The Exatron Stringy Floppy digital cassette-tape drive.*

In contrast, the Exatron digital cassettes, or *wafers*, are designed for digital recording. The tape is about 1/16 inch wide, and it is a closed loop moving in a single direction. It works in a manner similar to that of an eight-track audio tape cartridge. The tape is pulled out of the middle of the single reel and is wound up around the outside. No rewinding is necessary because the tape forms one big loop. The tape runs past the read/write head fast enough to transfer data at 7200 bps (bits per second). The wafers are about the height and width of a business card and about 3/8 inch thick.

Stringy Floppy Characteristics

The basic control software for the Exatron Stringy Floppy system is stored in ROM (read-only memory) located inside the drive, making the system easy to use. The addressing of the ROM fits cleverly into an otherwise-unused gap in the TRS-80's memory-address space. The control software uses 4 bytes of read/write user memory. All you have to do to activate the control software is type "SYSTEM" to the Level II BASIC interpreter and then type "/12345". There are three ROM-based commands available: @LOAD, @SAVE, and @NEW.

To load a BASIC program from the wafer, you simply type "@LOAD*n*" (where *n* is a file number from 1 to 99), and within a few seconds the program will have been loaded into user memory. To store a BASIC program on the wafer, you type "@SAVE*n*". The system verifies that the program has been stored correctly, so this takes a little longer. To load and store machine-language programs, you use the same commands, adding arguments (in decimal radix) to specify the load-starting address, the length of the program, and the program's entry point. In

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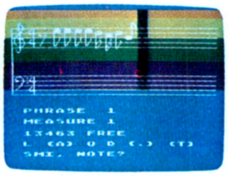
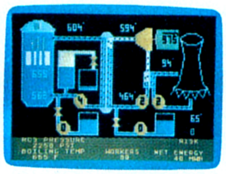
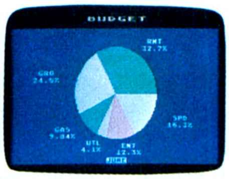
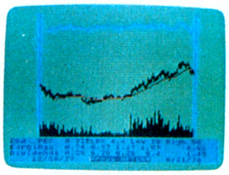
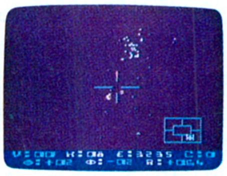
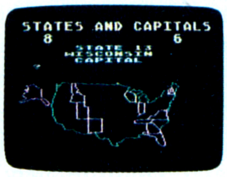


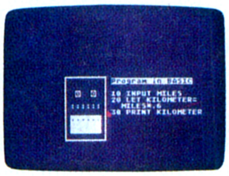






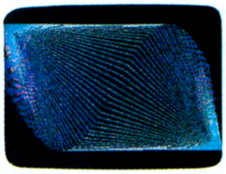






```
10 INPUT MILES
20 LET KILOMETER=
  MILES*1.6
30 PRINT KILOMETER
```

HOME TIME VISITORS
16 0:00 10



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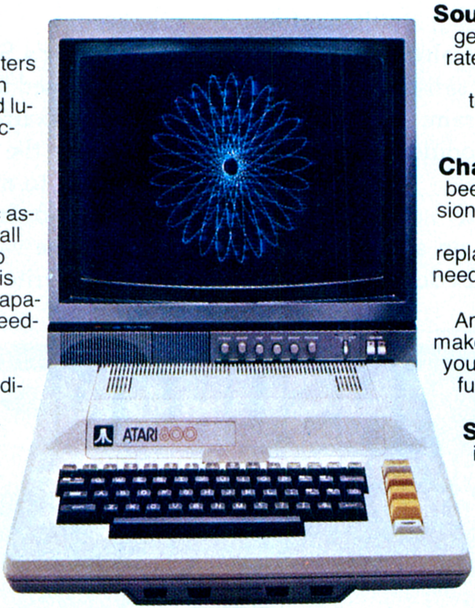

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addition, if you use "@LOAD*n*" from inside a BASIC program, it will chain program files while saving variables.

The @NEW command certifies a wafer for use. When you type "@NEW", the system writes a test pattern on the wafer, verifies it, and then displays the amount of storage space available on the wafer.

Storing data is just a little more complicated. A data-I/O (input/output) program that must be loaded into user memory is provided on a wafer. It takes up about 1 K bytes of memory. When loaded, it provides five more commands: @OPEN, @INPUT, @PRINT, @CLOSE, and @CLEAR. The uses of the first four are similar to corresponding commands in disk-based systems, and detailed explanations are included in the manual. The command @CLEAR is used for aborting open files and setting up I/O buffer space when you have more than one drive.

The system is not without some minor problems. First, no matter how well a tape-based system works, it is still a sequential-access system. That is, it may have to read all the files preceding the file you wish to access. (Since the Exatron drives are comparatively fast, this is less irritating than it sounds.)

Furthermore, the method of storage allocation leads to some interesting problems. If you read a program from a wafer, modify the code so it is longer, and then rewrite it onto the same wafer, the longer program will destroy the header of the file behind it. I have made it a policy (after losing several hours' worth of work) always to use a "scratch" wafer until I am absolutely satisfied there are no more changes to be made to a program. Another way to avoid this problem is to write the modified program as the last file on a wafer.

A second problem (one familiar to users of audio cassettes) is that there is no directory on a wafer of the files it contains. I use 3 by 5 file cards cut down to the size of a wafer to manually record the wafer's contents. I write the file names on the card and always keep that card with the wafer.

The last problem involves those 4 little bytes of user memory that the operating system uses. You won't be able to use every byte of memory in a 16 K-byte system. I was dismayed, at first, to find that I couldn't load some large programs from the Stringy Floppy. (Fortunately for devotees of games like the Scott Adams Adventures, a special loading routine has been developed for use with Adventure International products.) Of course, the 4 bytes are missed less by owners of 32 or 48 K-byte systems.

The 4 bytes will be relocated just below any area at the top of memory reserved for machine-language programs. If you don't reserve memory for machine-language programs, the 4 bytes will reside at the top of memory. If you have a machine-language program that attempts to load over these 4 addresses, either it won't load at all or it won't run correctly.

One way of increasing the data-transfer rate of the TRS-80 version of the Exatron Stringy Floppy system is by speeding up the Z80 microprocessor within the TRS-80. Exatron sells a speed-up kit that roughly doubles the processor's clock rate and the Stringy Floppy's data-transfer rate. Unfortunately, wafers recorded at the higher rate can be read only by a TRS-80 that has been speeded up.

Manufacturer's Support

I am impressed by the documentation and support provided for the Exatron Stringy Floppy. First, enough information about the operating system is provided in the user's manual to make assembly-language programming of wafer-I/O operations simple. Entry points to ROM routines for the various primitive functions (read block, write block, write file header, verify block, etc) and an

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explanation of the error-detection system are included.

Second, a starter kit is available that includes some immediately useful software: the data-I/O program, two I/O-demonstration programs, a machine-language monitor called ESF-80, which resembles Radio Shack's T-Bug, and a mini-data-base program. The starter kit also contains documentation, ten blank wafers, and a two-for-one ribbon cable for connecting the Stringy Floppy drive to the expansion port on the TRS-80 keyboard/processor module.

Third, for support after the sale, Exatron Corp has established the Exatron Stringy Floppy Owners' Association, through which a variety of software is available on wafer, including games and utility programs. Membership is automatic when you purchase a Stringy Floppy drive. The association also distributes instructions for modifying popular commercially sold programs to work with the Stringy Floppy drive. Such patches are available for the Electric Pencil word-processing program from Michael Shrayer Software and for the Editor/Assembler Plus from Microsoft Consumer Products. Members of the association are encouraged to contribute to the software collection and to a collection of hardware interface designs, sometimes in exchange for royalties.

Fourth, Exatron maintains a toll-free telephone number you can call if you need more help than you can get locally. The number is (800) 538-8559. California residents can call (408) 737-7111.

Other Planned Products

In addition to the version for use with the TRS-80 Model I, Exatron has recently announced a Stringy Floppy drive for use with the Apple II computer. The new system differs from the TRS-80 version in several ways. The operating system for the Apple will not be resident in ROM; it will be loaded into 6 K bytes of the Apple's user memory by a bootstrap routine when the Stringy Floppy system is activated, in much the same manner as popular disk operating systems. The Apple version will provide a catalog on each wafer, residing in the first file, and the standard data-transfer rate will be higher, about 16,000 bps. As the owner of a TRS-80, I envy these features.

Because Exatron is designing Stringy Floppy drives for some Commodore Business Machines computers and for the Radio Shack TRS-80 Color Computer, owners of these machines may look forward to having the Stringy Floppy added to the selection of peripheral devices.

Conclusions

- The Exatron Stringy Floppy system is an excellent low-priced alternative to slow audio-cassette data storage. The system appears to work well despite some minor bugs. Exatron apparently has worked hard to make both the hardware and its operation simple and efficient.
- Both documentation and support appear to be good, and toll-free telephone assistance is a reassuring asset.
- Thanks to the efforts of Exatron and the owners' association, an adequate supply of software converted to run on the system is available.■

At a Glance

Name
Exatron Stringy Floppy

Use
High-speed mass storage on digital cassette

Manufacturer
Exatron Corporation
181 Commercial St
Sunnyvale CA 94086
(800) 538-8559
(408) 737-7111 (in California)

Price
First drive for TRS-80 Model I, $249.50
First drive with starter kit, $349.50; Second drive, $224.50
First drive for Apple II, $349.50; Second drive, $189.50

Dimensions
TRS-80 Model I, 6 by 4⅛ by 2⅜ inches (15.25 by 10.5 by 6 cm)
Apple II, 6¼ by 5⅞ by 3⅜ inches; (15.8 by 14.9 by 8.5 cm)

Features
TRS-80 Model I: on-board ROM-based operating system, 7200 bps data-transfer rate, LED indicators, automatic keyboard debounce; Apple II: LED indicators, built-in catalog function, 16,000 bps data-transfer rate

Additional hardware needed
TRS-80 Model I Level II computer and 40-pin ribbon connector; Apple II or Apple II Plus computer and interface card (card supplied with first drive)

Hardware options
TRS-80 Model I Speed-Up Kit (doubles processor clock rate and Stringy Floppy data-transfer rate), $19.95

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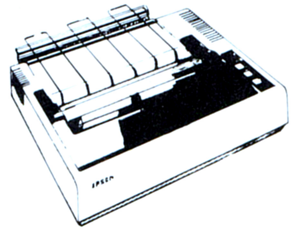

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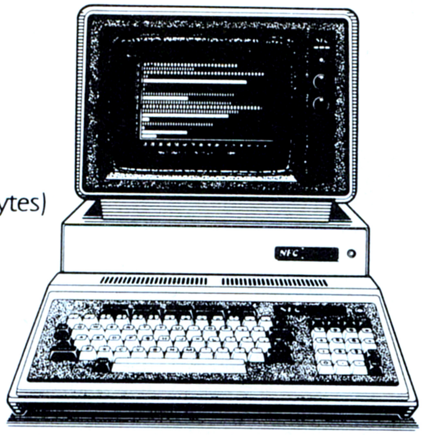

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Reviewing the Microcomputer Revolution

Ed Faber, President
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For the past five years, industry leaders have been telling each other about the microcomputer revolution, predicting it may even overshadow the industrial revolution. Of course, the beginnings of the industry go back more than five years, but 1976 marked the first anniversary of BYTE and the creation of ComputerLand, which celebrated its fifth birthday this fall by opening its 200th store.

With so many of the heady predictions of five years ago yet to be fulfilled, it's easy to lose sight of the changes we've already brought about. But one dream still unfulfilled is the emergence of a mass market for home computers. For ComputerLand stores, the home/entertainment market initially accounted for 50 percent of our sales. But by 1979, it represented only 25 percent, except at Christmas time. The home market has not dwindled; it has grown slowly while the business market has exploded. In fact, the events of the past five years might well be called the "office microcomputer revolution."

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The three basic reasons for the faster growth of the business market show what's required to develop a mass home market:

1. Business is not afraid of computers; business people are accustomed to them and perceive them as useful.
2. Computers *are* useful to business; programmers have had 30 years to turn hardware into solutions.
3. Channels of distribution and support already exist for business computers.

None of these requirements has been completely satisfied for the home market. The public is afraid of computers. Until recently, most people didn't know where to buy a computer or how to support one, and they didn't see any benefit to owning one.

Making the benefits known is largely the responsibility of manufacturers. The first two requirements can be met by the existence of full-service retail computer stores.

From my viewpoint, the major achievement of the past five years has been the creation of the structures that will carry the microcomputer revolution to its next stages. Those structures have had more to do with merchandising than with technology. In other words, the real revolution springs not from technology but from our making that technology available to a mass market.

Many will read that statement with sorrow, even if they agree. The entry of giant manufacturers, the growth of global retail networks, the emergence of advertising campaigns involving celebrities and network TV—all of these have tended to squeeze out the starry-eyed, blue-jeaned innovators who started the ball rolling.

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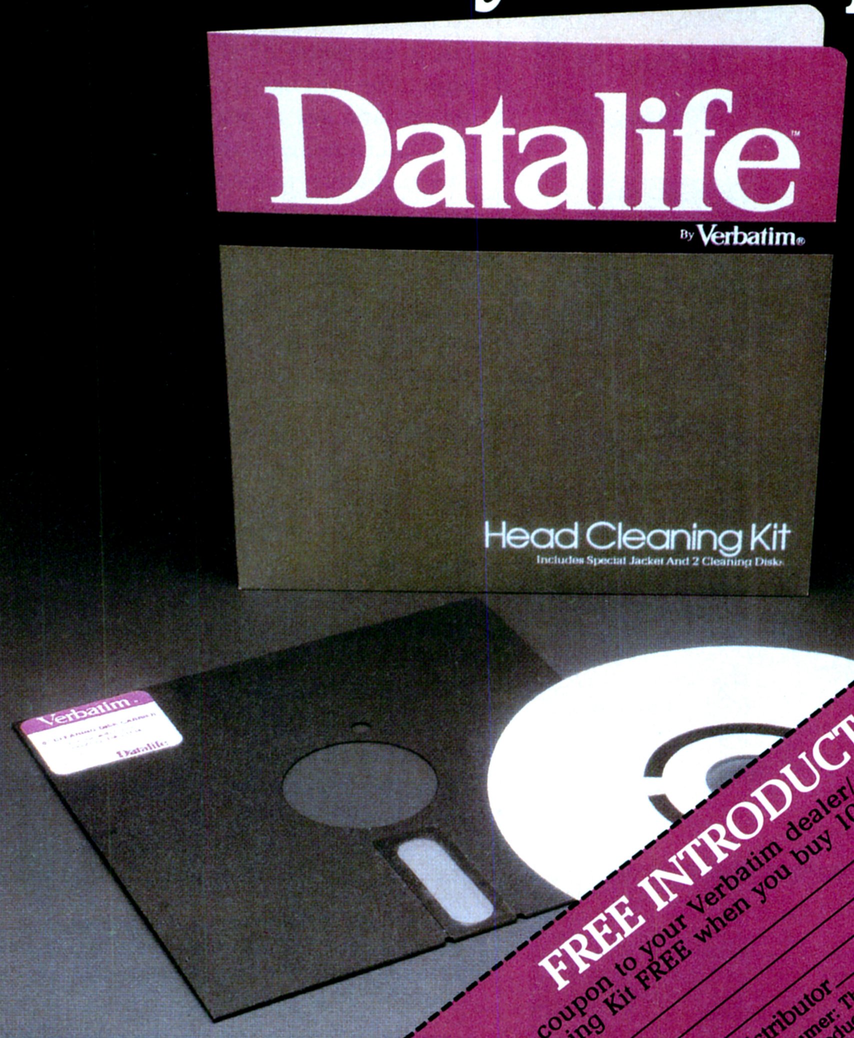

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sense of apprehension that prevails in the headquarters of successful companies. The question of the day seems to be "Who's gaining on me?" Instead of looking for a better and more valuable product, companies are aiming their strategies at the competition. Those who aren't afraid of IBM are afraid of the Japanese, or discounters, or Sears, or something.

Into this turbulent market I'd like to toss an idea, one we've used at ComputerLand and credit with our success: the market is honest. The companies that succeed are the ones that contribute value by building the best possible product and offering it at a fair price. I can think of no bigger mistake than for companies who became successful this way to begin reacting to what others are doing (or might be doing).

The potential market is much greater than anything we're competing for today. Any contribution to expanding the market can't fail to be repaid. The market will always have room for innovation, for products that improve on previous products or help solve new problems.

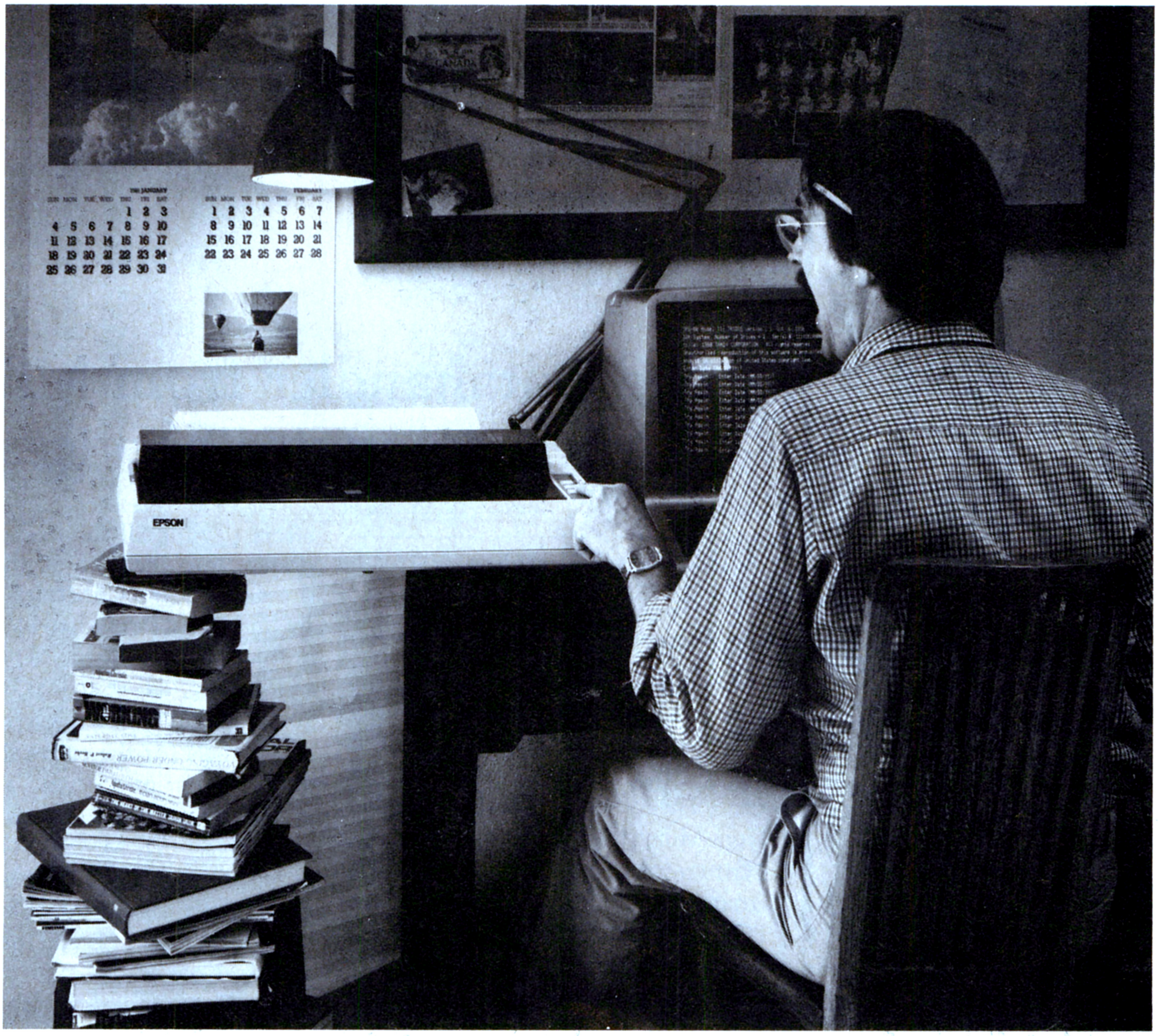
I believe much of the industry's apprehension grows out of a misperception about consumer marketing. Many manufacturers have not yet learned how to communicate to the general public or how to describe hardware benefits to computer illiterates. That doesn't mean computers should be sold like shampoo, with million-dollar ad campaigns and sex appeal. As shampoo marketers will tell you, ad campaigns are most important for products with few real advantages over their competitors. The market will always make room for a better product.

Innovation is also the answer for those who fear that Japan or some other country will steal the market through price erosion and superior manufacturing capacity. If the battle is fought on the basis of price instead of innovation, Silicon Valley hasn't a chance. If the battle is between cheaper and better, better will prevail wherever it comes from.

The companies to watch during the rest of this decade are the ones that concentrate on providng value to the end user. We happen to believe that value includes offering your products through full-service, full-support retail outlets. Be that as it may, the products with the most value to the end user are the ones that will succeed.

We are still on the threshold of the computer revolution; the greatest opportunities for manufacturers, retailers, and customers still lie ahead. No one now in the market or planning to enter it should fear anything more than the failure to bring value to the market. *That* is the challenge of the 1980s.■

Occasionally, BYTE invites industry leaders to comment on topics related to the microcomputer industry. The opinions expressed by these authors are their own and do not necessarily represent the opinions of BYTE or its publishers.



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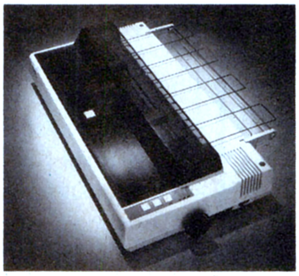
All in all, the MX-100 is the most remarkable printer we've ever built. Which creates rather a large problem for those of us at Epson.

How are we going to top this?



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System Review

The Datahandler from Miller Microcomputer Services

Allyn Richardson
POB 254
West Groton MA 01472

There are only two programs in my software library that I use constantly. One is the word processor that is helping me to review and edit *this* text. The other is The Datahandler from Miller Microcomputer Services. Written entirely in MMSFORTH (that company's version of the FORTH language for the Radio Shack TRS-80 Model I), The Datahandler does almost every job you expect of a personal computer except number-crunching—and it even does a little of that, as you will see.

For example, The Datahandler disk includes a checkbook and bank-transaction routine that is the best of its kind. It can generate a summary list of all transactions in a specified interval and provide a running balance for each. Adding a code letter to each entry that designates the source of deposits and the purpose of expenditures allows the output section of The Datahandler to give listings and totals for each class. With these summaries of your financial activities, the annual IRS formalities become a breeze.

There is also a mailing-list routine. Last year, with its help, I got through my entire Christmas-card list before Christmas for the first time in years. Previously, I got a few cards out by Christmas, some by St Valentine's Day, some by Easter/Passover, and many never made it at all. It took less effort to type all the names and addresses into the TRS-80 than to address one year's Christmas envelopes by hand, and I only had to type them in once. Now that the data is in the computer, I can select and automatically print self-adhesive address labels for the entire list or any desired portion, such as family members, personal friends, business associates, my MMSFORTH users' group, or monthly accounts. The address labels save a lot of work, and the system makes certain that nobody gets overlooked.

The Datahandler is also ideal for creating different catalogs, and it has built-in automatic cross-indexing. For example, I keep a catalog of all my phonograph albums on floppy disk. Each disk entry (called a *record* in computer data-base terminology) in the MASTER LIST data file corresponds to one album in my collection.

Each data record has five fields of information: an accession number, title, description, subfile, and code. The *accession* number tells *where* the phonograph disk can be found. When a file is resorted, this number stays with its file record, even though the records themselves are renumbered in a new sequence. The *title* field includes composer or performer, and the *description* includes the publisher's name, product number, and the number of separate musical pieces on the album.

The *subfile* field points to a separate listing in another file on the same disk containing more detailed

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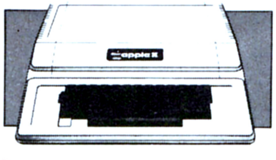

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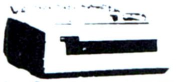

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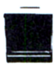

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information. When all the subfiles have been built, requesting a musical selection will give a list of all versions in the collection, where each may be found (including the side and band of the album), when, where, and by whom each was performed, and a critical comment. You can see how this would be useful for a radio broadcaster handling requests from listeners while on the air.

Another worthwhile application is the ability to organize the contents of journals and periodicals. Finding that particular article in an extensive periodical collection can be quite a job. But if you have a Datahandler file of articles indexed by subject, author, title, when and where published, and a brief abstract, finding the desired article is no problem. An additional benefit is that Datahandler can scan all entries on a particular subject for relevant articles.

Of course, building this kind of data base from scratch takes time. If you are a member of a computer group, each member could build a file on a different publication with The Datahandler and all members could share their files.

The number of data bases is limited only by your imagination and your need to organize and control information. Photographers could catalog their prints, amateur radio buffs could keep their station logs, sports fans could keep individual and team records—the list goes on and on.

Anyone interested in learning about or using the FORTH language will appreciate several of the data files included on The Datahandler disk. A member of the MMSFORTH Users' Group has developed and made available a glossary of standard FORTH words (ie: program-coding commands) in Datahandler file format. This file can be accessed and used by anyone operating in FORTH, or it can be modified, updated, or extended using the Datahandler. Whole new vocabularies, such as the nonstandard FORTH words of which The Datahandler itself has been constructed, can be added. The routine allows listing by word class, gives a description of what the word does and how it is used, and includes a page reference to MMSFORTH's hard-copy documentation for more information.

Another data file, known as ASSEM, is included for assembly-language users or students. ASSEM contains the 149 commands of the Zilog Z80 microprocessor's instruction set and the associated page number in the TRS-80 Editor/Assembler user's manual from Radio Shack. Both are cross-referenced to the equivalent MMSFORTH Z80-assembler command (the same elements but with arguments and operators in reverse-Polish sequence) and (where applicable) the older MMSFORTH 8080-assembler equivalent. The Editor-Assembler manual provides a detailed description of the operation of each instruction.

The Datahandler's formatted hard-copy output is provided by the REPORT routine. You can print a line listing of all fields in each record of your file, or a selected subset. If the records are longer than one line, subsequent lines are indented and an extra line feed can be inserted between records. REPORT gives the option of generating a custom format, listing your file or selected subset with fields in any order. The format is completely under user control and can be set for your video screen or your printer's line and page length. It automatically truncates field lengths to fit your requirements. Unless you want it to, printer output does not include the various computer-generated prompts and operator responses of the interactive program.

Speed is one of the advantages of this data-base system, a direct result of the nature of the FORTH language (for specific information on this language, see the FORTH theme issue of BYTE, August 1980). The threaded interpretive structure of FORTH makes possible an indexed-sequential file organization. This combines the efficient use of memory space of a sequential file with the speed of random access. The memory efficiency is important because both The Datahandler program and the entire current data file are resident in the TRS-80 user memory to improve the response time of the system.

In FORTH, source code precompiles as it loads, and thus it occupies a minimum of memory. Once loaded, the compiled FORTH code is very fast. Precompiled code can be saved on floppy disk, reloaded, and reused. While it takes eighty seconds for The Datahandler source code to load and compile, the precompiled code loads

At a Glance

Name
The Datahandler

Type
Data-base-management utility program

Manufacturer
Miller Microcomputer Services
61 Lake Shore Road
Natick MA 01760

Price
$59.95

Format
5¼-inch floppy disk

Language used
MMSFORTH

Computer needed
Radio Shack TRS-80 Model I with a minimum of 32 K bytes of memory, one floppy-disk drive, and the MMSFORTH system.

Documentation
Reprint of the Scelbi PIMS manual, additional text from MMS, and built-in help functions to guide users through the program.

Audience
For persons who need a program to help organize and manage information using their TRS-80.

Additional comments
Requires MMSFORTH system, $129.95, for operation.

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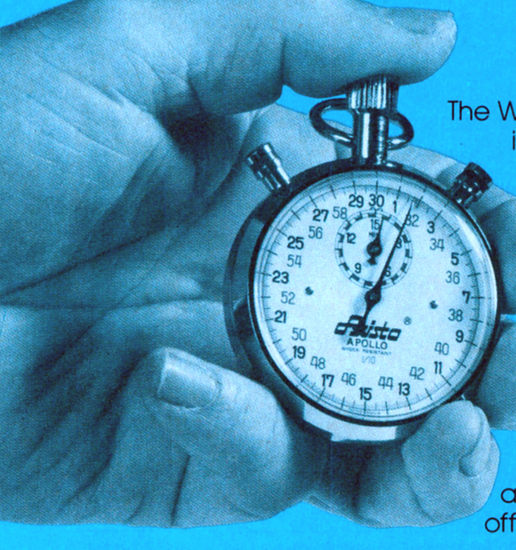

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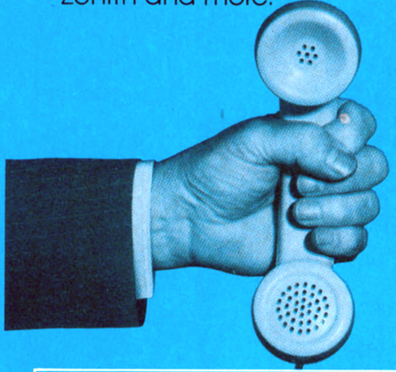

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in less than eight seconds. Once loaded, the system disk is not needed for file operations because, as mentioned above, all the program code is in memory. The remaining space on the system disk can be used for file storage, or it can be removed and replaced with a data disk, transferring control to the new disk directory usually located at block zero. On multiple-drive systems, control can be switched at will from one directory to another for access to the files on each; it is even possible to have one directory refer to more than one disk. This can be complicated, however, requiring that such disks always be used as a set, each in its proper drive.

Both the source code and the precompiled version of The Datahandler are useful, and both should be retained. The source code can be easily modified, whereas the precompiled program cannot. Modified source code can be precompiled and saved on the disk; the documentation describes how this is done.

Once the program is loaded, how much space is left for holding a file? If you have a 32 K-byte TRS-80, about 9 K bytes. System overhead (device-control blocks, system stacks, etc) use about 3.5 K bytes while The Datahandler and the portion of the FORTH system it requires compile into about 19.5 K bytes. The remaining 9 K bytes of user memory are used efficiently, with data tightly packed. Each entry is linked to the next by a 2-byte address pointer to eliminate the vacant space at the end of partially filled or empty fields, which are often found in other data-base programs. For many personal applications 9 K bytes is enough; with a 48 K-byte system, the data space is about 25 K bytes, enough for a fairly large file.

If still more space is needed, you can split your data file into two or more parts, usually with no loss of convenience. For example, my phonograph-album file has 245 entries, which exactly fills my 48 K-byte memory space. To make room for further acquisitions, I split my file into a "classics file" and a "general file" (jazz, folk and humor). A large mailing-list file could be divided alphabetically by addressee, or by zip code for presorted bulk mailings.

Having the entire file resident in memory is much faster than a system which uses frequent time-consuming transfers to and from disk. My memory-filling phono-record file has entries stored in order of accession number; resorting to alphabetic order by title takes 13.2 seconds. Sorting by code designation within the alphabetic sort increases this time to 14.1 seconds. Up to ten successive levels can be sorted. Sorts are the slowest of the file manipulations. Other operations occur as fast as you can punch the keys.

There are also small conveniences that speed up the human end of the operation. For example, when entering a group of checks written on the same day, you need only enter the date for the first entry; entering a semicolon in the date field of the

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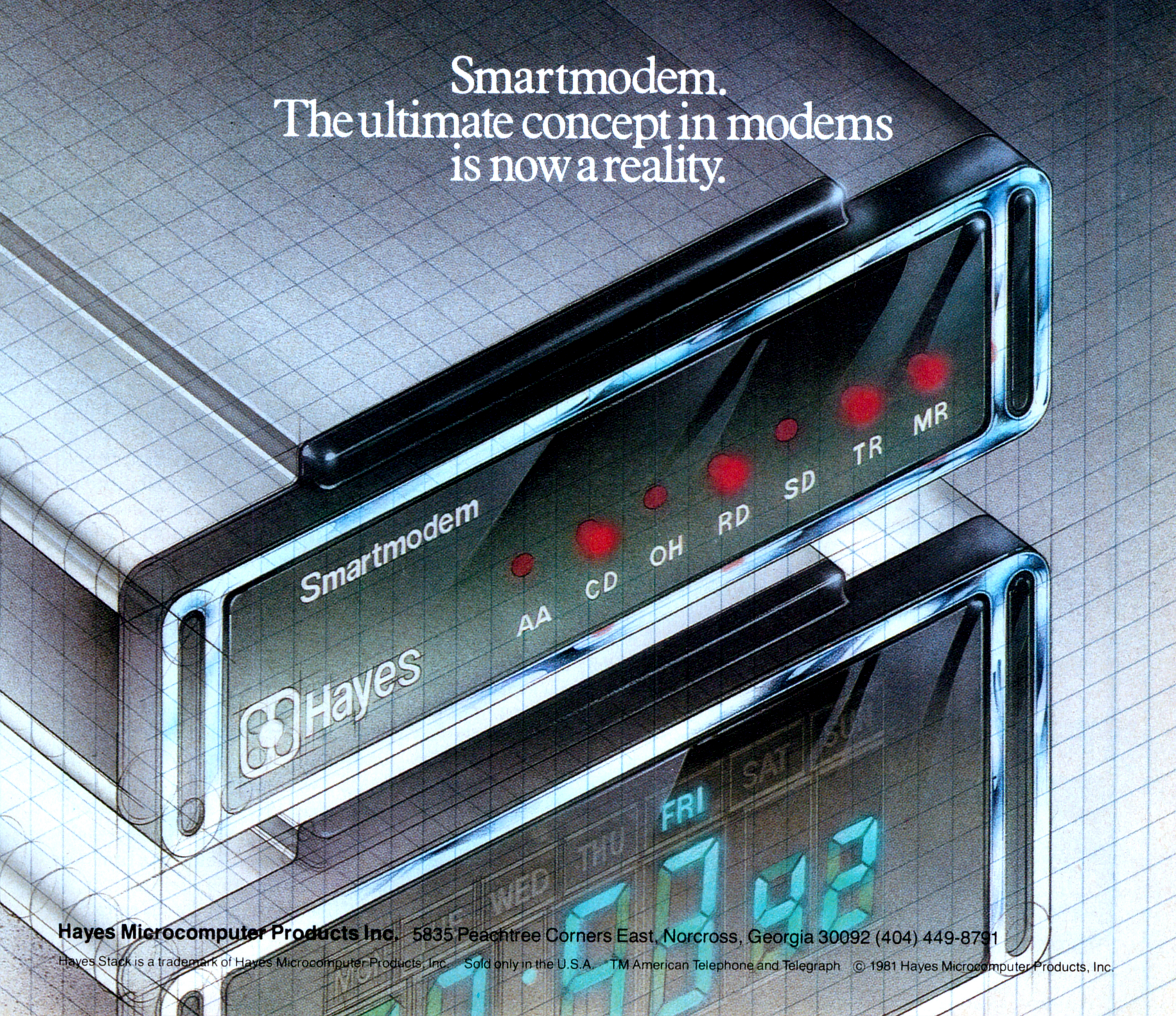

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subsequent entries copies the date information from the previous entry. This semicolon function can be used with any field, whether you're entering a series of articles from the same magazine, friends in the same city, or addresses with the same zip code. When updating a record, a null entry leaves the field unchanged, while entering a couple of spaces erases the previous contents, and any valid entry replaces the old data.

For search-and-match operations, you do not have to enter the exact field desired; The Datahandler will locate close matches if so directed. For example, if you want to find the account of Dr. Neilson but don't know the correct spelling of the name, you type in the name string (the target of the search in each record in this case) as "N??LS?N", and any alternative spellings will be located (eg: NIELSEN). The wild-card character, ?, indicates that any character in that location is acceptable. Even if you have lowercase capability and have recorded a name with initial-capital letters, instead of using all uppercase, it can still be located on the first try. By changing the program constant ?UL from its default value of 0 to 1 (the command in FORTH to do this is { 1 ?UL C! }), all lowercase characters will be regarded as uppercase for the purposes of string matches. This is very convenient for those with lowercase capability on their TRS-80.

Product Support

One of the most attractive features of The Datahandler is the excellent documentation. The well-known Scelbi PIMS (Personal Information Mangagement System) program, written in BASIC, provided the concept upon which The Datahandler was built. By arrangement with Scelbi Computer Consulting, the very fine PIMS user manual is supplied as the main documentation for The Datahandler. As in the original PIMS, The Datahandler leads you by the hand with the HELP command, which displays all available options, then supplies prompts that tell you what to do next. Additional text takes you step by step through all the operations, from loading the program to adjusting a custom report format (the most complex operation for a beginner), and using sample practice data files included with The Datahandler disk.

Beginners will find The Datahandler easy to use. Only an extremely experienced user will not require the prompts. Not only do they guide you through all the program options, they provide great flexibility in formatting a custom report. However, the versatility and interactive nature of this program can be a disadvantage. Some options or parameters will not change from day to day, and it can be a nuisance to have to reenter them every time.

This minor nuisance can be overcome if it becomes a problem. For those users familiar with FORTH programming, custom modification of some of The Datahandler routines (such as replacing the #IN routine, which receives keyboard input, with the desired parameter as a literal) is not too difficult. It's easy to eliminate unnecessary inputs while retaining needed flexibility. Even neophytes who know how to use the full-screen FORTH editor will learn a lot in the process.

If, on the other hand, you have a business application and want no part of programming, but do need custom modifications, the group at Miller Microcomputer Services (which includes Tom Dowling, author of both MMSFORTH and The Datahandler) can create a custom version. The typical cost is $500 to $1000, depending on the extent of the modifications. This is competitive with many business systems with fewer features, running twenty times slower in BASIC.

To get new customers started more easily (those who purchase both the MMSFORTH and The Datahandler disk with single-system licenses), MMS will provide a third disk customized for your system configuration and precompiled for eight-second loading. Though the firm does not promote this service, it is available on request for an extra $10.

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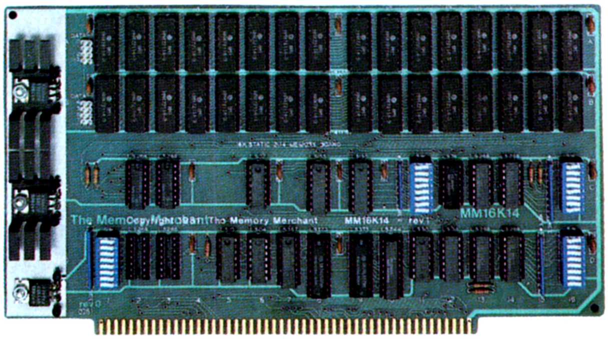

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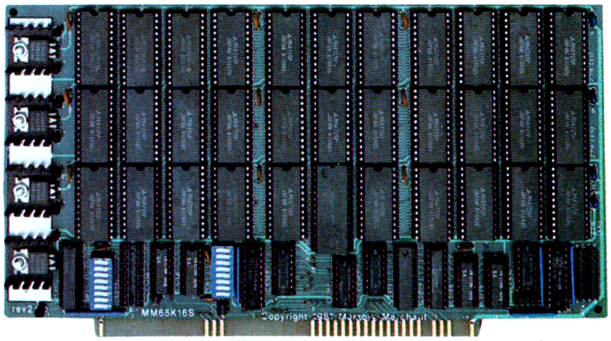

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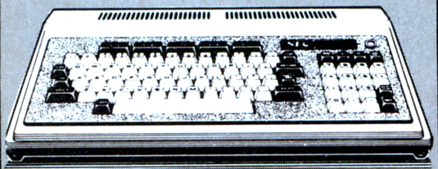

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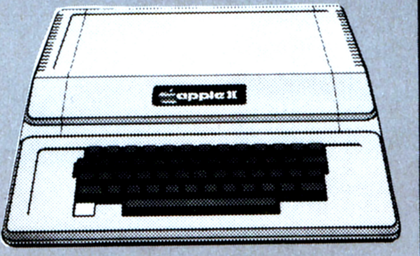

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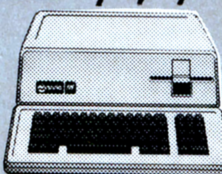

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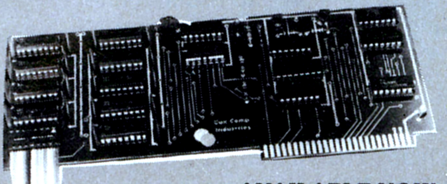

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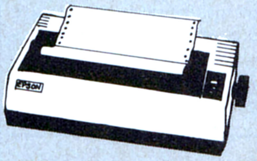

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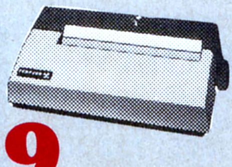

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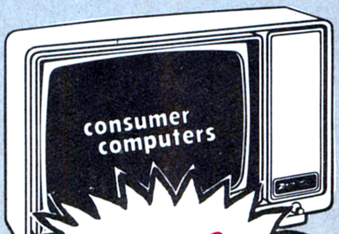

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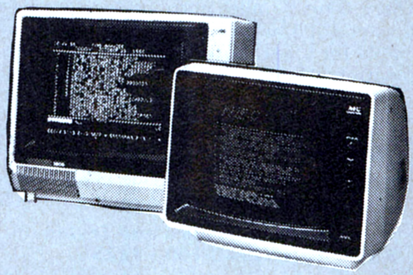

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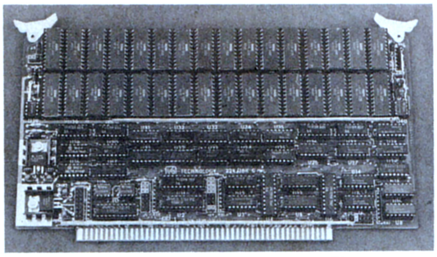

The **32K x 8 bit/16K x 16 bit** STATIC RAM BOARD uses low power and its fast device access time of 200 nsec (max.) allows for operation @ 4 MHz without any wait cycles.

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☐ Software page select/override ☐ Software wait cycle select (if slower devices utilized by user) ☐ External power source back-up capability for Memory Array ☐ Low input power requirements (full memory array - 150 MA max. @ 8 VDC IN — support logic - 500 ma typ @ 8 VDC IN) ☐ Socketed RAMs and support logic IC's for easy maintenance ☐ Comprehensive Manual

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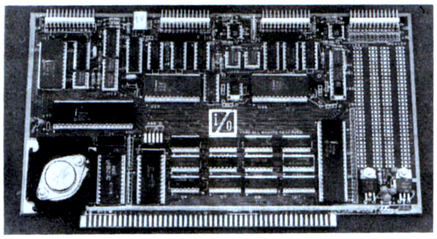

The multiple on-board functions allow for complete software and hardware I/O task(s) control.

Features: Two independent SYNC/ASYNC serial ports (Software programmable with status read interface: RS-232-C or current loop — 20 or 60ma — or TTL with handshaking. Dedicated output connectors for each port) ☐ One strobed 8-bit parallel port with handshaking (Software status read) ☐ Three 8-bit parallel ports undedicated & user configured (Software programmable for input, output, plus input/output/bidirectional with handshaking or combinations thereof. Software status read for handshake logic) ☐ Three independent 16-bit timers (Software programmable for 5 operating modes. Indiv. clock source input & gate control — int. or ext. Uninterrupted read. Two buffered outputs) ☐ Eight level priority interrupt controller (Software programmable highest interrupt level. 8080/Z80 auto restart command) ☐ Two software programmable baud rate generators with crystal controlled frequencies — .01% tolerance ☐ Large prototyping area with access to regulated +5, +12, −12VDC.

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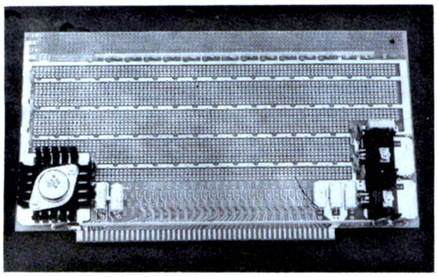

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The Datahandler program is upgraded and improved constantly. New capabilities beyond those already mentioned are often suggested by users. Features are added to the standard version only if their general usefulness is considered worth the extra memory they take away from the available file space. Other more specialized functions are distributed via the *MMSFORTH Newsletter*.

The user's original floppy disk may be returned to MMS for upgrading at any time. The fee for upgrading is $10, plus $1 shipping and handling. Fifteen dollars must be sent by the customer with the disk; the extra $4 is returned with the upgraded disk unless the original arrived damaged and had to be replaced.

The first two issues of the *MMSFORTH Newsletter* are complimentary to new MMSFORTH and Datahandler licensees. A subscription of four more issues costs $10. Considering the valuable information contained in these newsletters, most users will find them well worth the price.

The September-October 1980 issue, for example, provided information on a new utility disk providing a Z80 assembler, floating-point mathematical operations, a program for looking up source-code definitions of FORTH words, and a routine for converting lowercase text to uppercase. The issue also explained and listed the programming needed to access the interrupt-driven clock in the TRS-80 Expansion Interface and its use in timing operations. Also included was a listing and discussion of the latest addition to MMSFORTH version 1.9, which reports available memory space on the directory-menu screen whenever DIR is entered, and uses no additional memory space itself. There were other suggested improvements a user could make without waiting (and paying) for a full upgrade, news of coming events, short tutorial articles by Tom Dowling, and a listing of user-group contacts scattered throughout the nation.

The Datahandler is a personal data-base management and utilities

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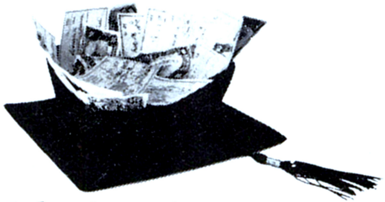
package of impressive capability, well documented and easy to use. If you want to make the most of your TRS-80, this program provides the best way I know to put it to work organizing and managing information. If you have or can upgrade to a 32 K-byte system with one or more floppy-disk drives, it is well worth the price to acquire MMSFORTH, if only to use The Datahandler. With 48 K bytes of user memory and a printer, many small-business tasks can be managed very capably. For the FORTH programmer, The Datahandler can be used as a starting point for a wide variety of custom applications, since source code is provided and FORTH programs are characterized by ease of modification and extension. Programs run about twenty times faster than equivalent operations in BASIC and compile into relatively little memory space.

The Datahandler, with complete documentation and a single-system license, sells for $59.95. MMSFORTH with license and equally good documentation is $129.95, giving the TRS-80 user an additional powerful computer language and operating system.

I have the first Datahandler sold by MMS and have been an active member of the users' group since it was formed. In this time I have heard of no user who is less than enthusiastic about the program's features and many uses. Most users of a suitably configured TRS-80 should find many constructive ways to put The Datahandler to work.

Conclusions

- The Datahandler is a data-base management utility for TRS-80 Model I microcomputers, ideal for personal use and for many business applications.
- It requires at least 32 K bytes of programmable memory and one floppy-disk drive. A memory size of 48 K bytes with two drives and a printer complete an ideal system for most uses.
- MMSFORTH is required as the operating system and also gives you a powerful new language with many advantages. No knowledge of FORTH is needed to use The Datahandler.
- Advantages include excellent documentation and interactive programming for easy use by anyone, many convenient features to speed keyboard operations, and very fast computer operations, including fast sorting. Routines are included for maintaining a mailing list, printing address labels, checkbook balancing, and custom reporting. The Datahandler is completely flexible in number and size of fields and field titles. Custom report formats for special needs can be tailored to order by MMS and by many other competent programmers. A wealth of powerful routines in source code are provided from which the professional can rapidly assemble custom software.
- Disadvantages are limited to the fact that very large files which cannot fit within the computer's user memory must be divided into sections that do fit. For the applications for which this utility was primarily intended, dividing files is seldom necessary and causes little inconvenience when it is; the speed of operation achieved by having the entire file in user memory is of more value. I know of no other major disadvantages.
- The cost of the entire Datahandler/MMSFORTH package (with single-system licenses and documentation) is, in my opinion, very reasonable and would not be out of line for The Datahandler alone.
- For the programmer, source code is provided and custom modification is not difficult. In fact, this one utility program can be used as the starting point for a wide range of special application programs. ■



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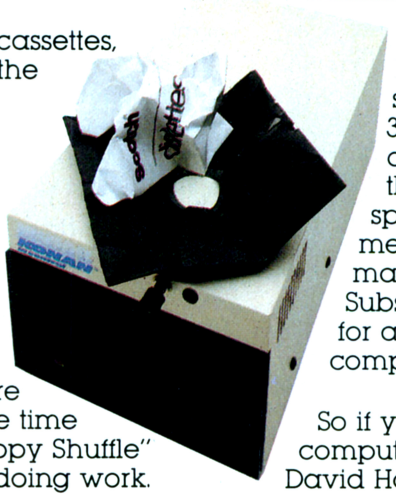

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Microsoft Softcard

Mark Pelczarski
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The Microsoft Softcard offers Apple owners increased flexibility and a strong alternative or complement to the Language System from Apple. At a suggested retail price of $399 Softcard comes with version 2.2 of the CP/M operating system and Microsoft's BASIC-80, version 5.0.

In addition, a number of other Softcard support products are available, including Microsoft's FORTRAN and COBOL, an assembly-language development system, a BASIC compiler, muMath and muLisp, and 16 K-byte memory expansion cards. None of these are inexpensive; for example, the COBOL language system retails for $750 (making FORTRAN seem like a comparative bargain at $195), but the point is that you can now have these languages, plus a variety of software already written for CP/M, on your Apple.

Overview

The Softcard package comes with the card, 13- and 16-sector disks, and two thick manuals. The card is manufactured for Microsoft by California Computer Systems of Sunnyvale, California, and was designed by Don Burtis of Burtronix in Huntington Beach, California. With the exception of slot 0, it works in any of the Apple peripheral slots and the Softcard package will work alongside the Apple Language System. The Language System actually extends the ability of the Softcard system by providing an extra 12 K bytes of programmable memory. The Softcard is not compatible with the Apple III. It does work with all of the 80-column boards now available for the Apple II.

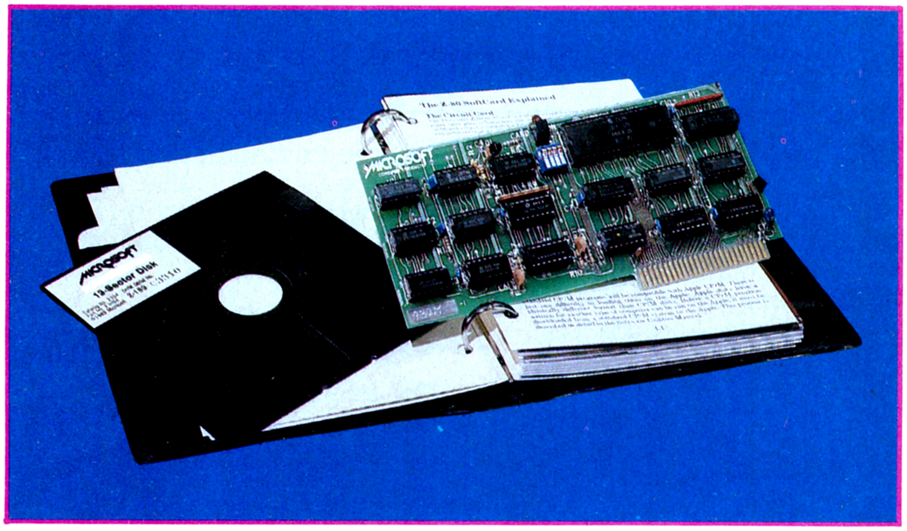

Photo 1: *Microsoft's Softcard package. Included are the card itself, software for the Apple II, and a two-volume set of manuals (with installation instructions, information on using CP/M, hardware details, Microsoft BASIC reference, and documentation on other utilities.*

The software supplied is the CP/M operating system and two versions of BASIC. The 13-sector disk contains MBASIC, which is Microsoft's ANSI (American National Standards Institute) compatible BASIC-80, with a few additions to accommodate Apple's low-resolution graphics features. The 16-sector disk also contains GBASIC, which includes high-resolution graphics commands. CP/M, the operating system, is an abbreviation for Control Program/Microcomputer, and is licensed by Microsoft from Digital Research, Inc. This version of CP/M includes a variety of disk and transfer utilities, plus an 8080 editor/assembler/debugging utility. The software was produced by Neil Konzen, a name that will be familiar to anyone fortunate enough to own Synergistic Software's Program Line Editor, another of Neil's Apple creations.

Using the Softcard

The two system manuals are very thorough and provide simple to very technical information. One is for CP/M, the other tells how to use BASIC 5.0 and the included software utilities. The first subject covered is how to back up the master disk. The beginner will probably want to go from there to more familiar ground and play with some of the BASIC

About the Author

Mark Pelczarski is a software consultant and Director of Micro Co-op, a consumer buying cooperative. He previously was Editor of Soft-Side *magazine, and a computer science instructor at Northern Illinois University.*

Most small system users think all microcomputers are created equal. And they're right. If you want performance, convenience, styling, high technology and reliability (and who doesn't?) your micro usually has a price tag that looks more like a mini. It seems big performance always means big bucks. But not so with the SuperBrain!

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commands, learning how to use the operating system as the need arises.

BASIC 5.0 is a nice way to convert to a structured language. If you're already familiar with BASIC, Applesoft or another version, you won't be trying to learn a new language from scratch. The advantages of BASIC 5.0 include several new commands that support structured programming. (See table 1 for a list of enhancements and their descriptions.)

The most convenient additions are the inclusion of the ELSE clause in the IF-THEN statement, the PRINT USING statement for explicit formatting of output, the inclusion of real disk commands, replacing the ungodly PRINT Control-D commands of Apple's DOS, and BASIC's version of a DO WHILE loop: WHILE/WEND. An example of the latter, paraphrased, would be: WHILE this condition is true, keep repeating all the commands before the WEND statement. This version of BASIC is also compatible with current ANSI standards, so the use of BASIC programs written

Text continued on page 158

At a Glance

Name
Microsoft Softcard

Manufacturer
Microsoft Consumer Products
400 108th Ave NE
Bellevue WA 98004
(206) 454-1315

Price
$399

Computer needed
Apple II, 48 K-byte minimum storage, and a disk drive

Hardware
Peripheral card that fits in any of the Apple expansion slots (except 0). The microprocessor is a Z80A

Software
CP/M, version 2.2, from Digital Research, and Microsoft BASIC 5.0, 13-and 16-sector versions with Apple enhancements

Documentation
Two manuals, approximately 400 pages, one primarily about CP/M, the other about BASIC 5.0

Options
Microsoft's FORTRAN, COBOL, muMath, muLisp, assembly-language development system, and BASIC compiler; 16 K-byte memory expansion card (or the Apple Language System)

Audience
Those seeking to increase the software flexibility of their Apple II computers

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DISCAT (32K 1-drive Min) **Mod I, III $50.00**
This comprehensive Diskette Cataloguing/Indexing utility allows the user to keep track of thousands of programs in a categorized library. Machine language program works with all TRSDOS and NEWDOS versions. Files include program names and extensions, program length, diskette numbers, front and back, and diskette free space.

KFS-80 (1-drive 32K Min — Mod II 64K) **Mod I, III $100.00; Mod II $175.00**
The keyed file system provides keyed and sequential access to multiple files. Provides the programmer with a powerful disk handling facility for development of data base applications. Binary tree index system provides rapid access to file records.

MAILLIST (1-drive 32K Min - Mod II 64K) **Mod I, III $75.00; Mod II $150.00**
This ISAM-based maillist minimizes disk access times. Four keys — no separate sorting. Supports 9-digit zip code and 3-digit state code. Up to 30 attributes. Mask and query selection. Record access times under 4 seconds!!

COMPROC (Mod I & Mod III — Disk only) **Mod I $20; Mod III $30**
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UTILITY PACKAGE (Mod II 64K) **$150.00**
Important enhancements to the Mod II. The file recovery capabilities alone will pay for the package in even one application! Fully documented in 124 page manual! XHIT, XGAT, XCOPY and SUPERZAP are used to reconstruct or recover date from bad diskettes! XCOPY provides multi-file copies, 'Wild-card' mask select, absolute sector mode and other features. SUPERZAP allows examine/change any sector on diskette include track-0, and absolute disk backup/copy with I/O recovery. DCS builds consolidated directories from multiple diskettes into a single display or listing sorted by disk name or file name plus more. Change Disk ID with DISKID. XCREATE preallocates files and sets 'LOF' to end to speed disk accesses. DEBUGII adds single step, trace, subroutine calling, program looping, dynamic disassembly and more!!

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Some new features of BASIC 5.0:

AUTO—Automatic line numbering when entering programs.

BEEP—Sounds the "Bell," instead of using an invisible Control-G.

Boolean operators—In addition to AND, NOT, and OR, BASIC 5.0 has XOR (exclusive OR), IMP (implication), and EQV (equivalence).

BUTTON—Instead of PEEKing at locations to find if a paddle button is pressed.

CALL—Can be used to call Z80 and 6502 subroutines, and pass parameters to them.

CHAIN—Runs another BASIC program, allowing variables to be passed.

COMMON—In conjunction with CHAIN, passes variables to another program.

Disk I/O—OPEN instead of PRINT ""D OPEN"; likewise CLOSE, GET#, INPUT#, WRITE#, and so on.

EDIT—An in-line program editor.

ELSE—As in: IF X = 0 THEN PRINT "ZERO" ELSE PRINT "NOT ZERO"

Functions—New string functions INSTR, which searches for a substring, and STRING$, which allows repetitive string definition.

HSCRN—Tells whether a point on the high-resolution screen is on or off.

LPRINT—Outputs a line to the printer, instead of using: PR#1 : PRINT.

MERGE—Allows two program files to be merged.

MOD—Finds the remainder of a division. This was available in Integer BASIC, but it's not included in Applesoft.

PRINT USING—Allows formatting of output, and is much more flexible than HTABs and VTABs.

RENUM—Allows you to renumber your program lines.

SWAP—Interchanges the values of two variables without using an intermediate variable.

User Functions—Can be defined with multiple arguments, instead of Applesoft's single-argument functions.

Variable types—Includes integer, single, and double precision; up to 16-digit accuracy.

VPOS—Finds the vertical position of the cursor.

WHILE/WEND—A loop structure similar to FOR-NEXT, except it checks for a condition each time instead of counting.

Applesoft commands not supported:

Cassette LOAD and SAVE, STORE and RECALL—Cassette functions are not included at all.

ESC editing—Replaced with the EDIT function for line editing.

FLASH—No flashing characters.

HIMEM, LOMEM

Shape Tables—None of the shape functions, DRAW, XDRAW, ROT, or SCALE, are supported.

IN#, Pr#—Commands are already device oriented.

Table 1: *Comparison of the features available in Microsoft MBASIC 5.0 as supplied with the Microsoft Softcard and Applesoft BASIC.*

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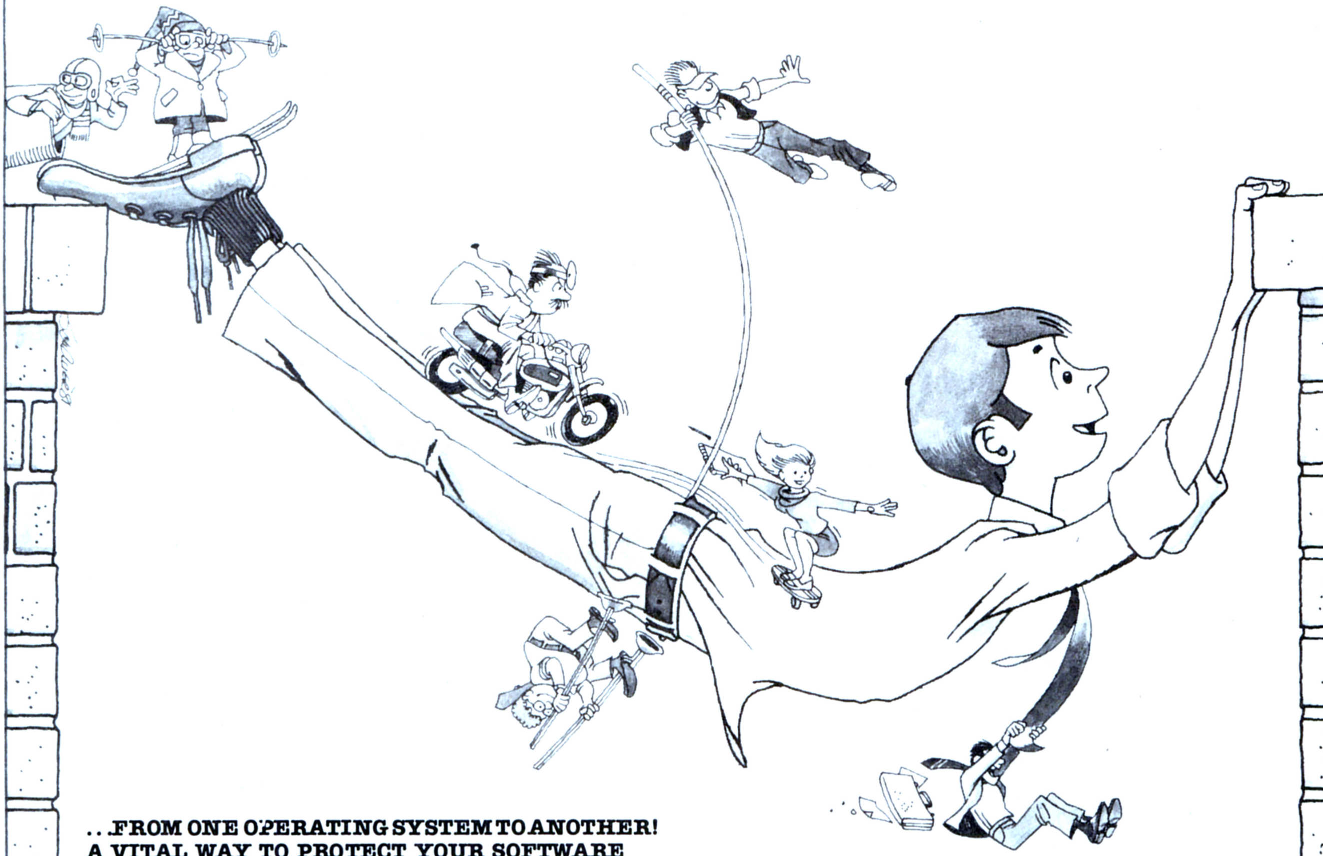

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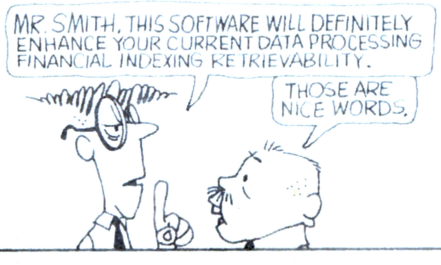
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Text continued from page 154:

for other machines using ANSI BASIC is possible.

After the language is loaded, about 14 K bytes of working storage are left on a 48 K-byte system. Hence, there are advantages to having the Language System or the optional 16 K-byte memory board. Either choice gives an added 12 K bytes of working storage. A 4 K-byte slice of that memory range is inaccessible: those are hexadecimal memory locations C000 thru CFFF, which are allotted for peripheral card I/O by the Apple. Another 4 K bytes, for the 6502 microprocessor's stack, the text screen, and other miscellany, are not available to the Z80, so Microsoft refers to 44 K- and 56 K-byte systems, rather than 48 K- and 64 K-byte systems.

CP/M for the Softcard is a complete version of the operating system. The command files provided with CP/M are shown in table 2. The standard CP/M 8080 assembler is included, along with a line-oriented text editor and DDT (Dynamic Debugging Tool) for machine-language programmers. Utilities are also available for transferring files from one device to another PIP (Peripheral Interchange Program), simulating batch jobs with disk input files (SUBMIT), dumping the hexadecimal contents of any file (DUMP), and transferring text and binary files from Apple DOS disks (APDOS).

Using Other CP/M Software

A language or operating system is of little value if it is nonstandard or can't be used with existing software. Softcard provides a DOWNLOAD program, a listing, and programming details for an UPLOAD program, that when loaded into respective systems (DOWNLOAD for the Apple, UPLOAD for another CP/M machine) allow the transfer of CP/M files from another CP/M system to the Apple through a serial RS-232C port. This does, of course, assume that you have the appropriate serial interfaces and another CP/M system available. A working knowledge of 8080 assembly language is also necessary for implementation of the UPLOAD program.

Another possible solution is to transfer CP/M files to an Apple DOS disk as a text file and convert that file to a CP/M file using APDOS. However, the text file created with the Apple DOS will use only a carriage return as a delimiter, while CP/M requires a carriage return and a line feed. Depending on the language, at this point, more tinkering is needed for the Softcard to understand your program. The saving grace to all nontinkerers is the fact that companies such as Lifeboat, Peachtree Software, Microapt and Structured Systems offer their CP/M software already on Apple-format disks. Also, the Computer Shack in Pueblo, Colorado, will, for $10, download any CP/M program you send them for use with the Softcard.

Using the 6502 from CP/M

It is possible for programs written for the Softcard to call routines writ-

Text continued on page 162

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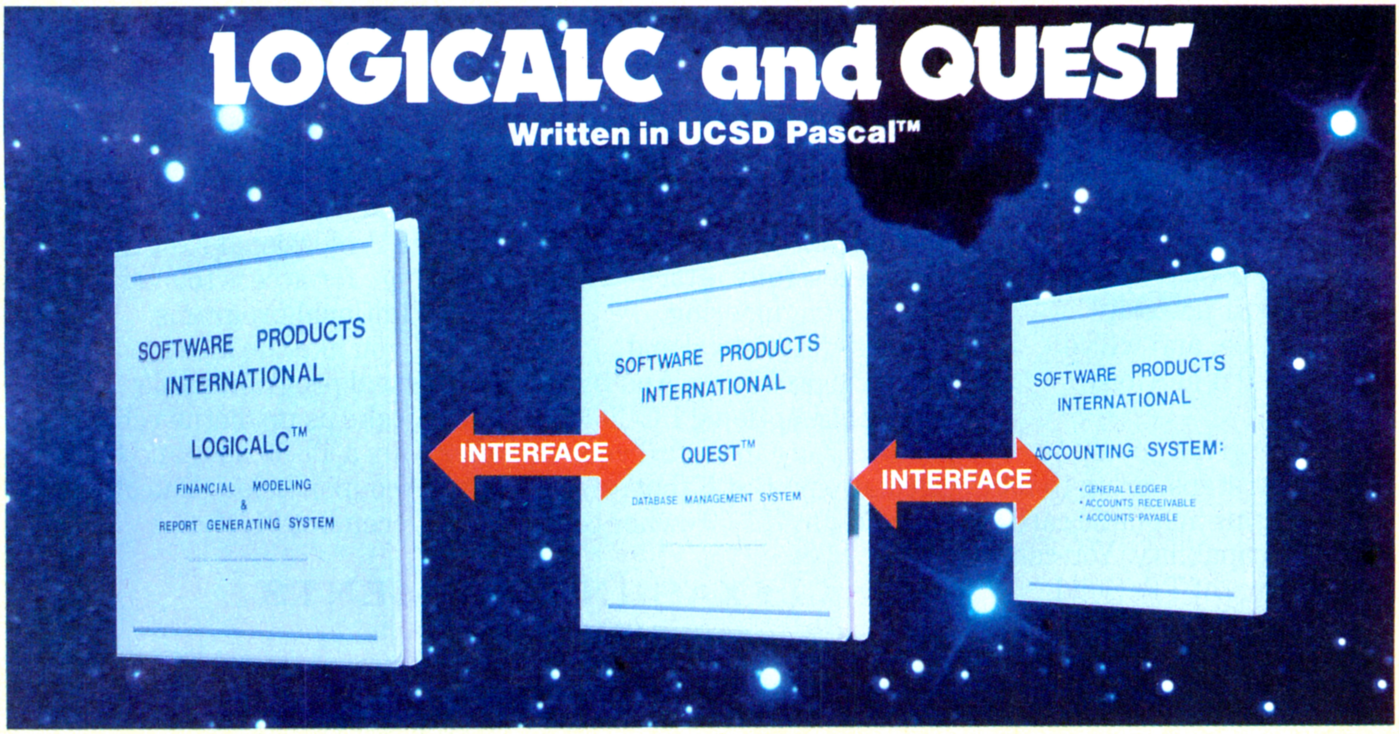
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- Create, restructuring and recover utilities of files
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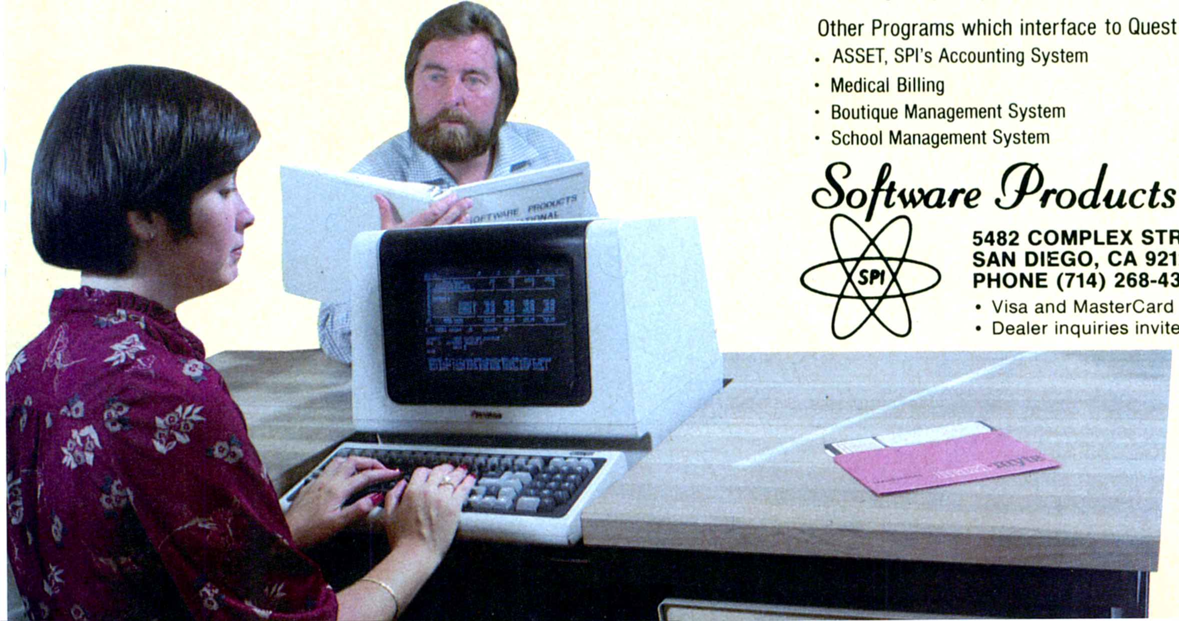

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1002

Built-in CP/M Commands:

DIR—Lists the disk directory.

ERA—Erases a file or files from disk.

REN—Renames a disk file.

SAVE—Saves a file to disk.

TYPE—Displays the ASCII contents of a disk file.

USER—Used to divide the disk into up to 16 separate user areas. USER specifies access to one of those 16 areas.

Transient Commands:

ASM—Loads the 8080 assembler and assembles a program from disk.

DDT—Dynamic Debugging Tool, an interactive machine-language debugging aid, allows program traces and editing.

DUMP—Displays the hexadecimal contents of a file.

ED—CP/M's editor utility.

LOAD-Creates a transient command file from a machine-language file on disk.

PIP—Peripheral Interchange Program, allows you to copy, merge, print, and load disk files.

STAT—Provides statistical information about disk space and device assignments.

SUBMIT—Executes the CP/M commands put in a special file with the editor program. Allows programs and commands to be batched together as Apple's EXEC command does.

CP/M Software:

APDOS—Allows transfer of ASCII and binary files from Apple-formatted disks to CP/M disks. This program requires two or more drives and cannot write CP/M files to Apple DOS disks.

CONFIGIO—Allows you to configure CP/M to your system, such as upper/lower case, 80 columns, and redefinition of keyboard characters for external terminals.

COPY—Disk copy utility.

DOWNLOAD—In conjunction with the UPLOAD program on another system, allows transfer of CP/M files to the Apple CP/M system.

FORMAT—Formats new disks.

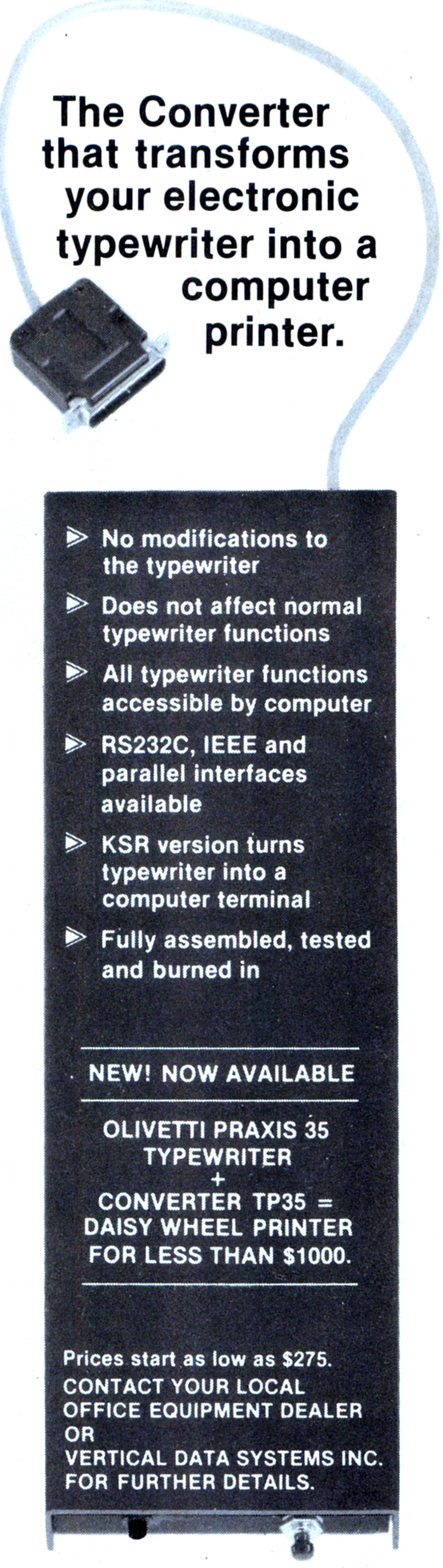
GBASIC—BASIC 5.0 with high-resolution graphics enhancements, provided on the 16-sector disk only.

MBASIC—BASIC 5.0, with some additional commands for use with the Apple.

RW13—Allows the 16-sector CP/M to read and write on a 13-sector CP/M disk.

UPLOAD—A listing of a program to be used on another CP/M system in conjunction with DOWNLOAD for transferring of CP/M files. A working knowledge of assembly language will be necessary to implement this program on another system.

Table 2: *List of the features and utilities of the CP/M operating system included with the purchase of a Softcard.*



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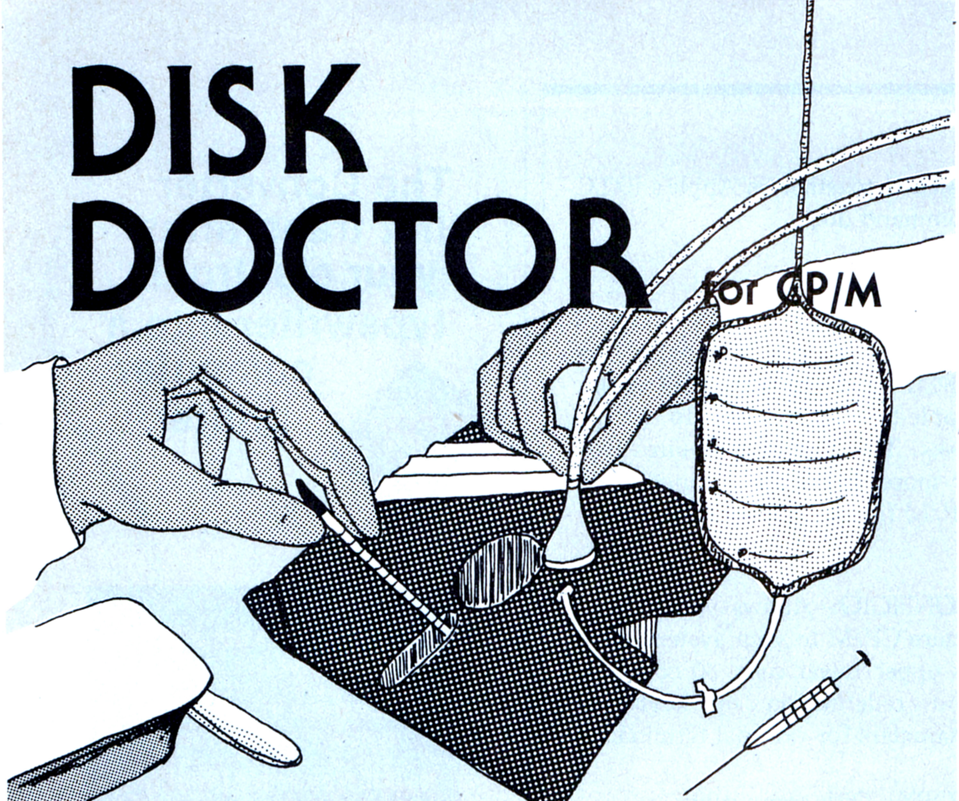

A Program to Recover "Crashed" Discettes AUTOMATICALLY!

Maybe it was a lightning storm, static from the rug, or just too late at night to be working. Whatever the cause, when a discette "crashes" and valuable data or programs are destroyed, the loss is enormous, both in time and money.

DISK DOCTOR is a program which automatically recovers bad discettes. Best of all DISK DOCTOR does not require any knowledge of CP/M file structure! If you can operate CP/M, then you can use DISK DOCTOR. The entire system is menu driven with key information displayed.

DISK DOCTOR is comprised of five "wards", each capable of performing a specific discette recovery operation.

- **Ward A:** Verifies discettes and locks out bad sectors without touching the good files that remain.
- **Ward B:** Copies whatever can be read from a "crashed" file and places it into a good file under user control.
- **Ward C:** Copies discettes without stopping for bad sectors. Bad sectors are replaced by spaces.
- **Ward D:** "Un-erases" files. That is, Ward D will recover accidentally erased disk files.
- **Ward E:** Displays directory of recoverable erased files.

DISK DOCTOR will pay for itself the first time it is used.

Best of all, DISK DOCTOR operates almost complete automatically. The small amount of user interaction is explained in the manual as well as prompted by DISK DOCTOR.

Requires: 48K CP/M, two drives needed for complete operation.

DISK DOCTOR:	$100.00
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Text continued from page 158:

ten for the 6052 processor. The Z80 is enabled with a memory write to a specific location. This *soft switch* can be toggled back to the 6502 with a similar write performed by the Z80. 6502 subroutines may be called by putting the subroutine address in a predesignated location, then toggling the soft switch. Values can also be passed to the 6502's A, X, Y, and status registers through another set of specified memory locations. The only confusion may come from the fact that the Softcard re-maps the Apple's memory to conform to CP/M standards. This means that the same location will have different addresses under the 6502 and Z80 modes. Apple's zero page has been moved to the top of the Z80's memory, so the Z80's location zero is actually hexadecimal 1000 to the 6502. This may sound confusing, but the adjustment is not difficult.

Conclusions

Because of the flexibility it offers Apple users, I consider the Softcard an excellent buy. Despite the introduction of many new and often better languages, three of the first popular computer languages (FORTRAN, COBOL, and BASIC) continue to enjoy the widest use. Although I'd like to jump on the Pascal bandwagon, I don't think that it and other languages will replace any of the above three. New languages will be used, but the trend is that existing languages continue to evolve to keep pace with the times. Look at BASIC. It's hardly recognizable from its original version or the version of FORTRAN of which it was supposedly a subset. The cost of rewriting software and retraining programmers is just too high to allow drastic changes or entirely new languages. The Softcard lets you choose among the many standards of the industry as it now exists. It has the most current version of BASIC, is capable of handling COBOL and FORTRAN, and uses CP/M, the closest there is to a standard operating system for microcomputers. The price is reasonable, and it works.■

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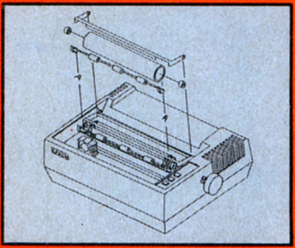

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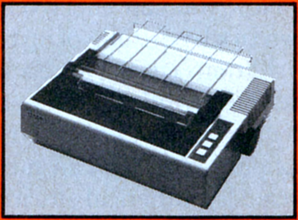

MX 80....(List $645) $ Call

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MX 80 FT includes Friction Feed..............................(List $745) $ Call

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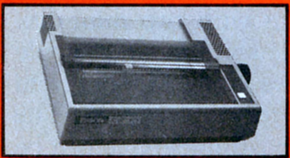

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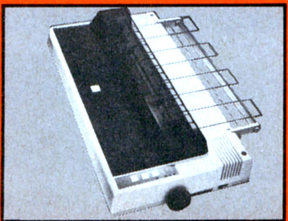

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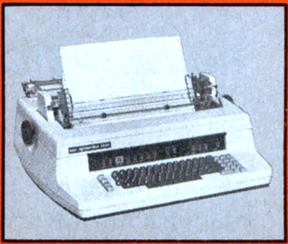

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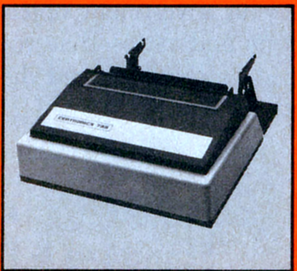

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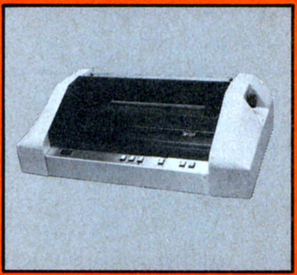

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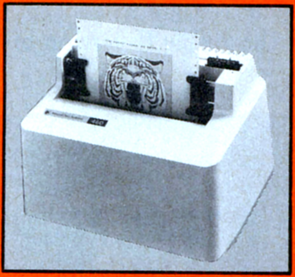

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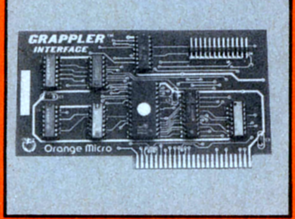

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Software Review

CourseWare Magazine

Elaine Holden
Reading and Language Arts Coordinator
Merrimack School District
Merrimack NH 03054

One of the problems limiting the use of microcomputers in the classroom is the lack of good educational software. This comes as no surprise, since hardware developments have always outpaced software developments. The problems of generating educational software, however, are compounded by the fact that most educators do not have the technical skills to write good programs and, conversely, most good programmers do not have the educational background to design useful programs.

CourseWare magazine was started to fill this gap. Its philosophy, as stated in the introduction:

"Each issue of *CourseWare* magazine will include a C-10 cassette containing at least two programs selected from the ten pre-college curriculum areas of business, consumer economics, English, fine arts, foreign language, industrial arts, mathematics, physical education, science, and social studies, or from the area of teacher-assistance programs. Each student program will be accompanied by a teacher guide, a student guide, worksheets (if applicable), suggestions on how to adapt programs for individual lessons, a description of variables used in the program, and a listing of the program. Teacher programs (computer-managed instruction, computer-supported instruction) will be accompanied by a user guide."

In using the materials given in the Apple II version of

At a Glance

Name
CourseWare magazine
(September 1980)

Type
Software and documentation
for classroom use

Publisher
CourseWare
4919 N Millbrook #222
Fresno CA 93726

Price
$12.95 (or 5-issue subscription, $50)

Format
Cassette

Language used
BASIC

Computer needed
Apple II or II Plus, Commodore PET, or Radio Shack TRS-80 Model I

Documentation
28 pages, in a 3-ring binder

Audience
School teachers with access to one of the computers listed above

$12.95 in U.S.A.
$13.50 in CANADA
SEPTEMBER 1980 VOLUME 1, NUMBER 1
COURSEWARE
PROGRAMS FOR LEARNING
MAGAZINE
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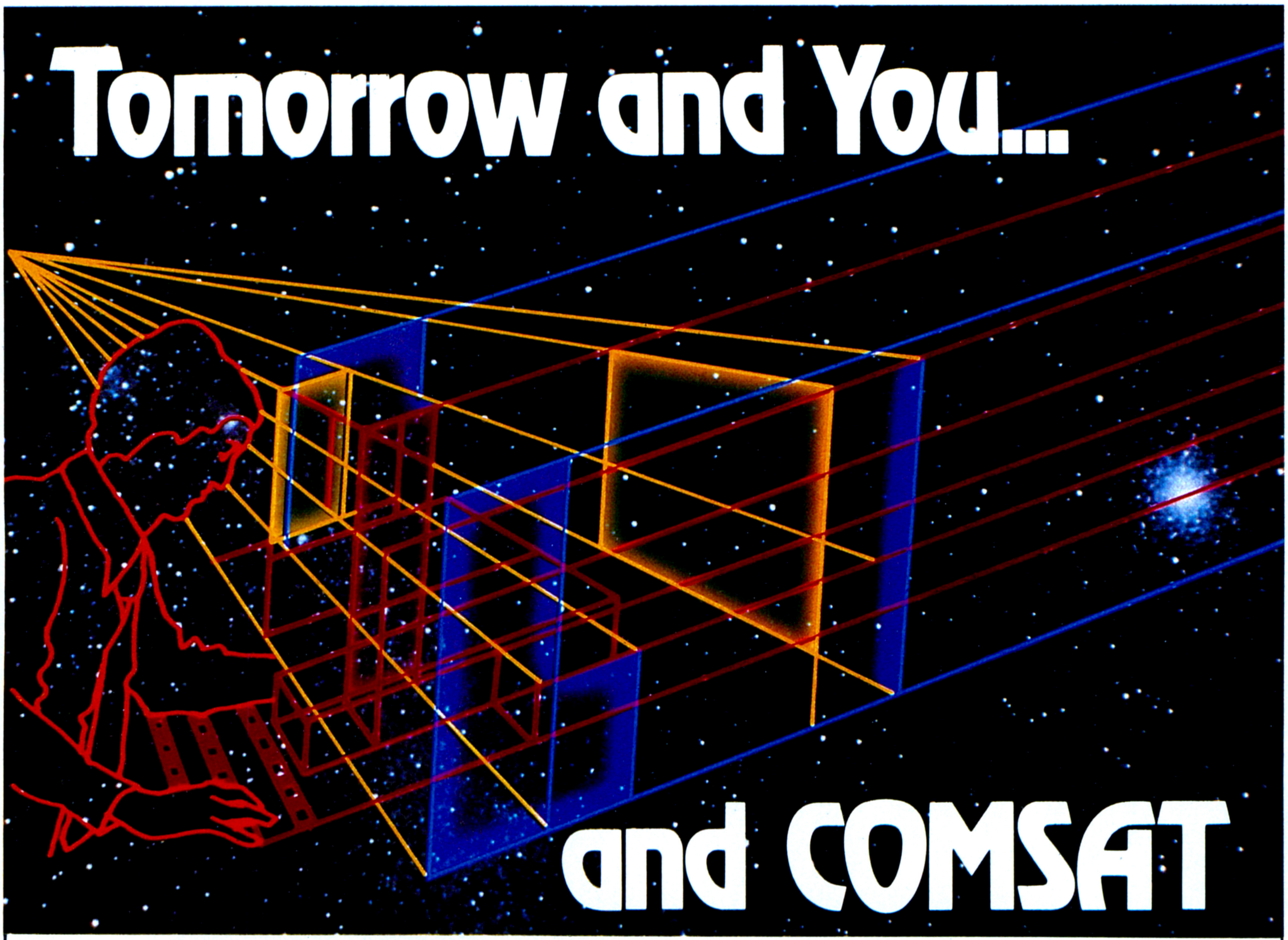
Quizstat
CourseWare Magazine
PET
SPELL 'N' TIME
QUIZSTAT
APPLE ☑
PET ☐
TRS-80 ☐

Photo 1: *September 1980 issue of* CourseWare *magazine. Each issue includes a cassette tape of the programs in that issue; separate versions are available for use with the Apple II or II Plus, Commodore PET, or Radio Shack TRS-80 Model I.*



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  a partnership venture brings video conferencing, electronic intra-company mail transfer, information and more, via satellite to business and government.
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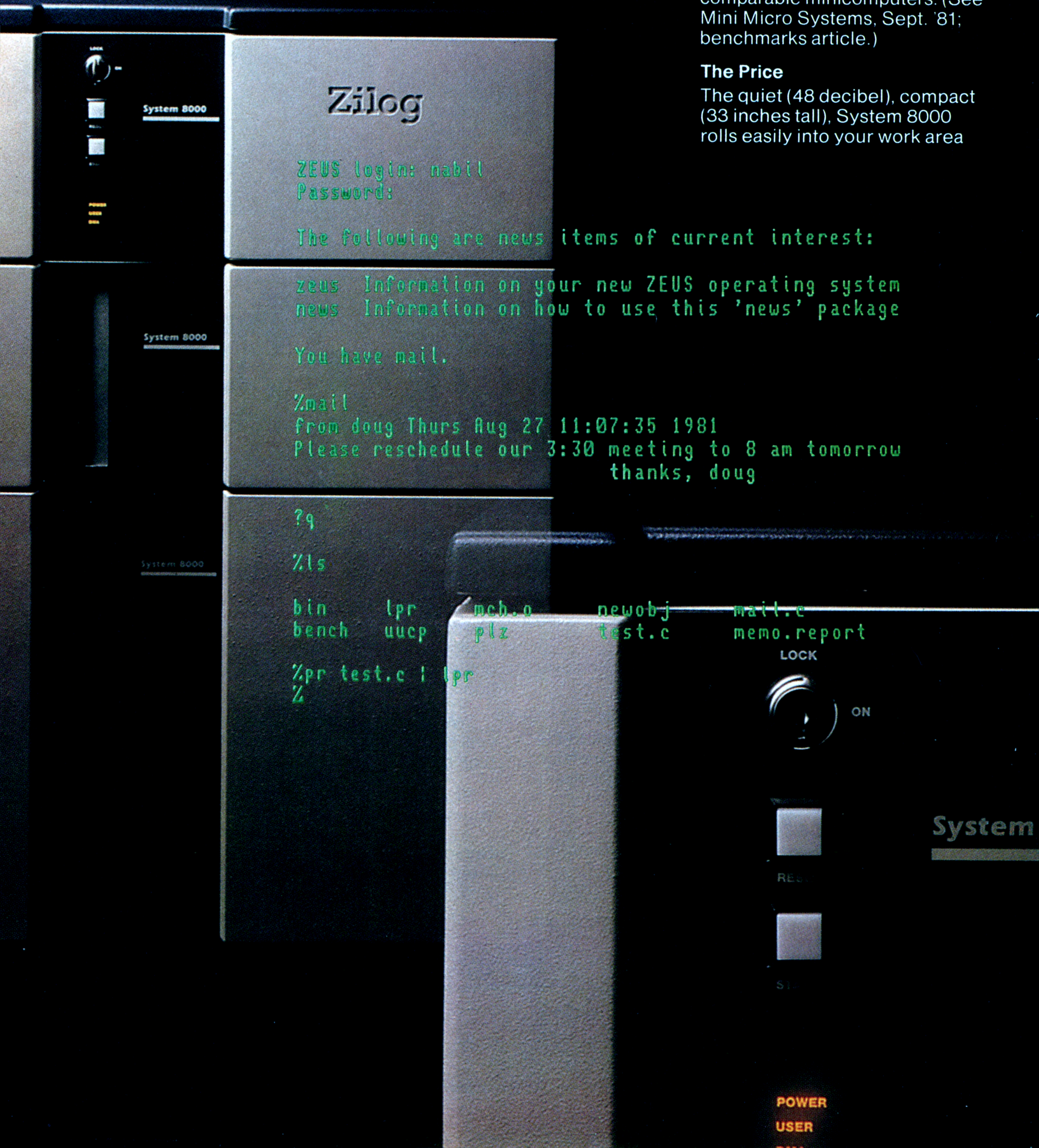
If you want to establish a low-cost UNIX*-based system, or need additional UNIX productivity on your current system, Zilog's System 8000 is the perfect choice. System 8000 is a modular, free-standing unit built for multi-user office and laboratory application. Based on Zilog's reliable, high performance Z8000™ microprocessors, System 8000 delivers supermicro power at prices far below those of comparable minicomputers. (See Mini Micro Systems, Sept. '81; benchmarks article.)

The Price

The quiet (48 decibel), compact (33 inches tall), System 8000 rolls easily into your work area



```
ZEUS login: nabil
Password:

The following are news items of current interest:

zeus  Information on your new ZEUS operating system
news  Information on how to use this 'news' package

You have mail.

%mail
from doug Thurs Aug 27 11:07:35 1981
Please reschedule our 3:30 meeting to 8 am tomorrow
                            thanks, doug

?q

%ls

bin     lpr    mcb.o    newobj    mail.c
bench   uucp   plz      test.c    memo.report

%pr test.c | lpr
%
```

the Supermicro.

and requires no special environment. Zilog provides a complete eight user system, including system software, 256 KB of main memory, a 24 MB Winchester disk and 17 MB tape cartridge back up, along with expansion capabilities, all for only $29,950. (U.S. list.)

The Performance

The System 8000 runs the ZEUS operating system, which is a faithful enhancement of the seventh edition of UNIX, perfected through Zilog's extensive UNIX experience. Because ZEUS is a high performance implementation of UNIX, any program that runs under UNIX, written in C, COBOL, or Pascal, can be easily ported to System 8000. Programs comprising the utilities and development tools provide user access, command processing, file management status information, and communication with other devices or systems. ZEUS also includes text processing software, libraries, a symbolic debugger, programming languages (standard C, PLZ/SYS, PLZ/Assembler, plus optional COBOL and Pascal), and more than 100 other utilities.

The Future

System 8000 plans include hardware and software expansion as well as compatibility with future generations of microprocessors. Soon the System 8000 will become integrated with Zilog's Z-NET™ Local Area Network (LAN) for commercial distributed data processing. No other manufacturer offers a UNIX-based system with the price and performance of the System 8000. So, if you're seeking the right UNIX solution, System 8000 is the perfect choice.

For more information, write Zilog, Inc. General Systems Division, 10460 Bubb Road, Cupertino, CA 95014. Or call the office nearest you.

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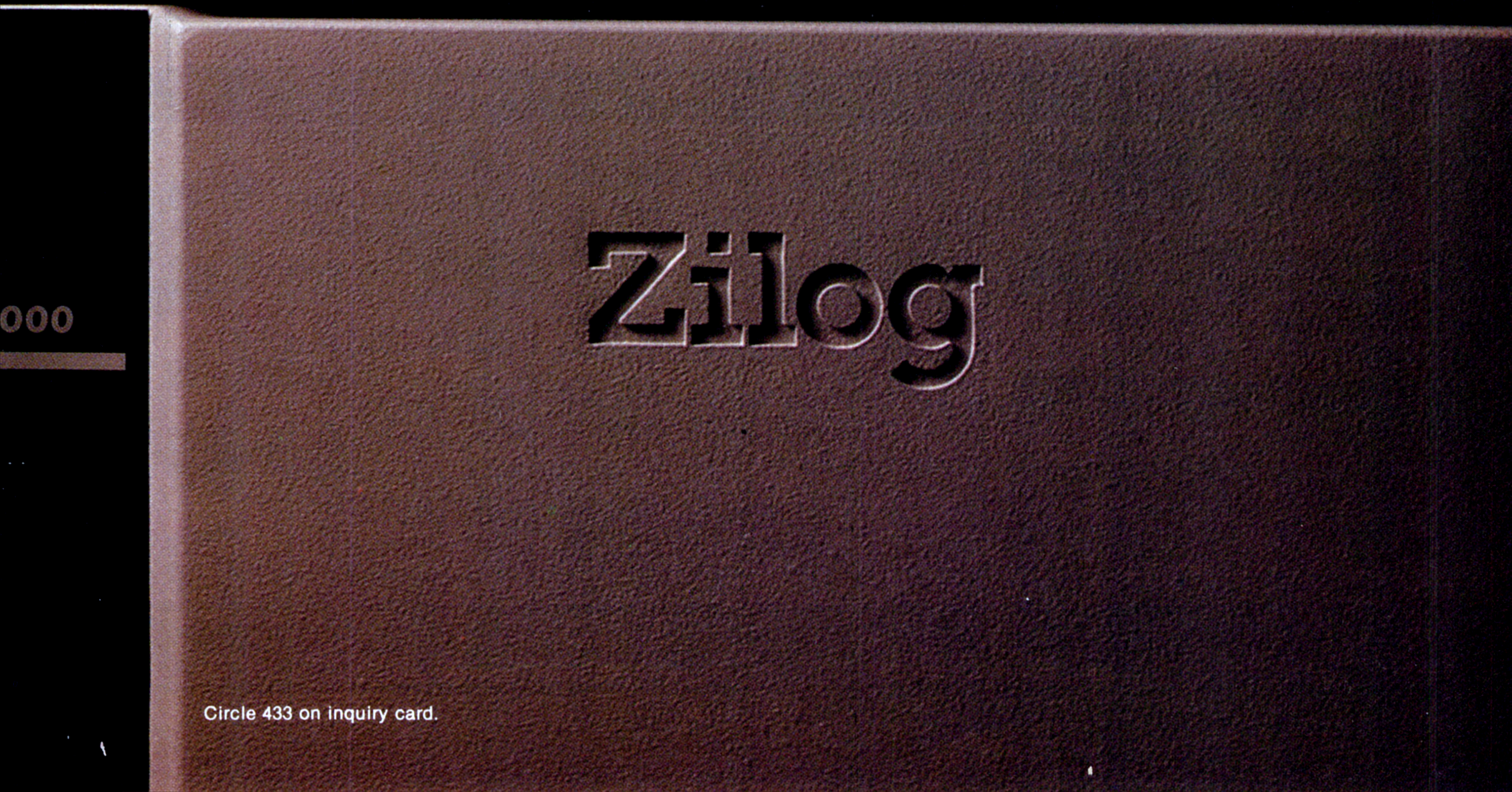

Circle 433 on inquiry card.

the first issue, September 1980, I found that these objectives were met.

SPELL 'N' TIME

I loaded the first program, SPELL 'N' TIME, without any problems. SPELL 'N' TIME is an electronic version of the traditional spelling bee, in game format. The drill can be used at all grade levels and for any subject. It is especially useful in subjects where specific vocabulary recognition is important.

SPELL 'N' TIME works like this: a student starts up the program and the computer prints "watch carefully." A box with an arrow pointing to it appears on the screen. The program displays and erases a word in the box, and the student spells the word in a box below. If the answer is correct, the computer prints "Good job!," and another word is presented. If the answer is incorrect, the program gives a short, nonthreatening sympathy message, "Sorry, try again." After one misspelling, the word is displayed syllable by syllable, and the student tries to spell the word again. If he/she does not spell the word correctly the second time, the word is continuously displayed while the student types in the word correctly.

This process continues for each word in the list. The number of correctly and incorrectly spelled words is displayed at the bottom of the screen. When the last word is finished, the computer gives a list of the incorrectly spelled words, which the student is to copy onto his/her worksheet (a master copy is provided in the documentation).

To the student, the program is a game, since the objective is to finish the word sequence as quickly as possible. All students can experience success:

- the presentation time of words depends on the individual's word recognition and spelling accuracy
- the word selection can be matched to the student's ability level
- there's immediate positive feedback for a correct response

An introduction states what the program does, what computers it runs on, its objectives, and why it is useful in a classroom. Explicit instructions tell how to change the number of words to be used (one program line must be changed), and how the teacher can change the actual words to be used (by typing the words, hyphenated with dashes, into one or several DATA statements). With only minimal computer experience, I was able to make both kinds of changes and save the changed program under a new program name.

By using the program, the teacher may leave the quizzing to the computer and give special attention to each student's needs by monitoring the student's response and revising the word list.

Studies show that the best way to evaluate spelling is with a written test. Improvement in spelling often comes from regularly administered tests based on misspelled words found in the student's work and later corrected and practiced. SPELL 'N' TIME reinforces this basic concept. Students can practice on teacher-selected words and later take a written test. This testing method closely approximates methods recommended by current studies and, as such, the teaching matches the testing. Consistent teaching and testing eliminates confusion on the part of the student.

QUIZSTAT

QUIZSTAT, the second program in the September 1980 issue of *CourseWare*, is a management program. It gives the teacher statistics on classroom performance on a given quiz. Only the memory capacity of the computer limits the number of students this program can handle.

For a given test, QUIZSTAT tabulates the number of students who missed each question, the percentage of students who made the incorrect response, the overall

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class average, and a grade-percent scale. The information is entered and displayed in several frames. The first frame asks for the class size, the number of questions in the test, and other identifying information. In the second frame, the teacher types in the number of each question that was answered incorrectly (once for every time it was answered incorrectly). When this process is finished, the third frame shows a summary of each question, including the number and percentage of students who missed it. If 50% or more missed any given question, an asterisk appears beside the question number. A record sheet is provided in the program documentation for the teacher to copy the information from this frame. Finally, the fourth and fifth frames give the class average and a grade-percent scale. The program allows the teacher to correct transcription errors during data entry.

In its simplest use, the program helps the teacher determine which classes and which subject areas need work. When used in a pre-test/post-test system, the analysis of the pre-test data shows the teacher which material needs to be emphasized, and the analysis of the post-test data shows which areas were most effectively taught.

Conclusion

One criticism I have is that I would like to see documentation of certain statements made in the magazine. For example, in the introduction, passing reference is made to "four surveys made during the past five years." How comprehensive were these surveys? What were the actual results? That is not stated. Educators might want to see the research so an address should be given.

In a second example, questions answered correctly less than 50% of the time were flagged by the QUIZSTAT program. My question to the program designers is "what research supports this seemingly arbitrary figure?" I feel that at least 85% of all students, a standard figure for many educators, must pass a given test question. I hope these problems with documentation will disappear in future issues.

The two programs in the issue I reviewed are useful and complete. The importance of supporting the programs with worksheets and documentation cannot be overstated. One of the most exciting aspects of using this software is that program improvements and new ideas come to mind immediately, causing me (and, I hope, other teachers) to see new uses for the classroom computer.

The editor of *CourseWare*, Dr Dan Isaacson, is on the faculty of the School of Business and Administrative Sciences at California State University in Fresno, California. The material in the first issue reflects a knowledge of teachers' needs as well as a proficiency in computer science. [**Editor's note:** *At the time at which this review went to press, three issues of* CourseWare *had been published. ...***GW**] Efficient and creative use of the computer in the classroom will depend on programming efforts such as this.■

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I(nterchange) is a general purpose file maintenance program for use with the CP/M™ operating system. Since it is a single program written in optimized Z-80™ code, it is much faster and easier to use than other file maintenance programs. Features include: DIR as usual *plus* listing all files *excluding* those with a specified character(s), ERA as usual plus *exclusive* erases. Also, a "Q" switch can be used to query each erase, a "W" allows erases of R/O files without query (normally you are queried), and an "R" switch if system files are to be included, LIST permits listings and uses TAB, WIDTH, LINES and WRAP for control, COPY as usual plus *exclusive* copies and supports the "Q", "W" and "R" switches plus an "E" switch for query on existing files, STAT with ambiguous, unambiguous and exclusive listings and produces an alphabetized listing with file length, total directory entries and space used and unused, START-END allows for copying contiguous data files, and RENAME as usual plus ambiguous renames. Other commands include: QT, DATE, TIME and SETIT (for the QT clock board) plus CLEAR, RESET, HELP and TYPE. Disk copies can even be continued after a disk full condition by simply inserting a new disk. All of this in one program without ever having to leave I(nterchange) and wait until you see the speed improvement . . .

The price for I(nterchange) is $59.95 and the manual is available for $10.00 (credited towards purchase). I(nterchange) is recommended for 32K or larger systems using CP/M™ 2.0 or later. It will not run on an 8080 CPU and only User 0 is supported.

All programs are available on 8" SD or North Star 5¼" disk. Microstat is available for North Star Basic, Microsoft's Basic-80 (Rel. 5.0 or later) or compiler Systems CBasic2. Please specify when ordering.

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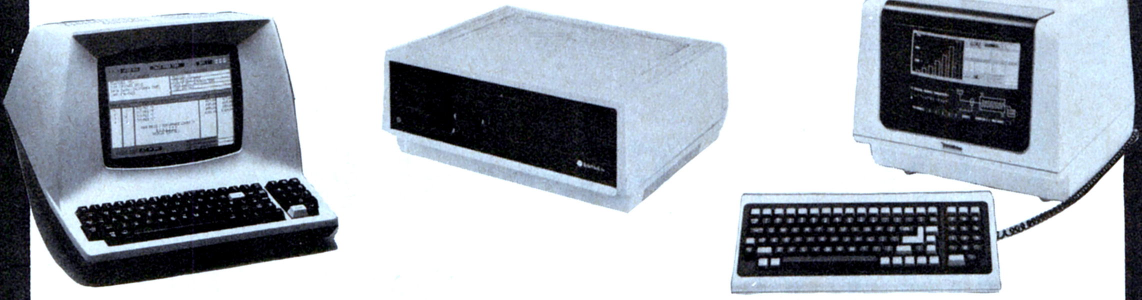

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DIF: A Format for Data Exchange between Applications Programs

Candace E Kalish & Malinda F Mayer
DIF Clearinghouse
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One of the most frustrating problems facing users of applications software is the inability to use the same data with more than one program. Users often know that one program has stored data with which a second program could work wonders, but incompatible storage formats make the data inaccessible to the second program. If you own an applications program, you ought to have control over the data in that program. But rarely do you enjoy full possession of this data.

Generating graphics from stored data provides a good example of this problem. Suppose you are using a data-analysis program to project your company's profits for the years 1980 to 1982. You enter data and run calculations, and the program produces table 1. You have a plotting program that can produce striking graphics to illustrate data, but the plotting program won't accept data in the format of the data-analysis program.

The need for a standard format for data exchange has long been recognized.

In the absence of a recognized standard format for data exchange between programs, you have only three choices for making the data from the first program useful with the second. You can retype all the data, write a program to reformat all the data, or modify one of the programs to accept data in a different format.

Each of these three data-transfer processes is inefficient and tedious. In a business environment, programs for billing, invoicing, inventory, ordering, and projections may all need the same data. Transferring data among all these different programs can take a great deal of time. Clearly, if all the programs used the same data format, the problems and inefficiencies would be greatly reduced.

Although many people see the need for a standard format for data exchange, we still lack such a standard. From time to time, individual users and commercial software houses have tried to establish a standard (particularly for use with VisiCalc, the electronic worksheet program written by Software Arts Inc and distributed by Personal Software Inc), but their efforts have failed to win wide acceptance.

Software Arts is now trying to provide a standard by offering DIF, a specific format for data interchange. The DIF file format stores tables of data and provides easy access to the data by any program using DIF. Many commercially available programs already use DIF, and more are coming soon. Some of the programs now available (in addition to VisiCalc) are VisiPlot, VisiTrend/VisiPlot, and CCA Data Management System, all from Personal Software Inc; TREND-SPOTTER, from Friend Information Systems, published by Software Resources Inc; and DB

About the Authors

Candace E Kalish is a freelance writer. Malinda F Mayer is a technical writer at Software Arts Inc. Contributing writers include Dena B Feldstein, publications manager, and Patrick J Slaney, programmer, both of Software Arts Inc.

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Master, from Stoneware Microcomputer Products. All versions of VisiCalc support DIF except VisiCalc 1.37 on the Apple II and VisiCalc PLUS on the HP-83/85.

The DIF Approach

DIF is easy for both beginners and advanced programmers to use and understand, yet it has sufficient power and versatility for most applications. Programs using DIF may be written in any language from BASIC to Pascal to assembly language. Furthermore, DIF is not dependent on the features of any particular computer. Because DIF avoids unusual features, data formatted in DIF can be transferred between programs regardless of the computers on which they are run.

Here are a few examples of DIF applications:

- Report generators and graphics programs can take data saved in DIF and produce easily grasped reports and vivid illustrations of what the data means.
- Programs that accept data from laboratory instruments can use DIF as a data-storage format, making the data easily accessible for later analysis by other programs.
- Periodic data stored in DIF can be consolidated later into a master report.
- If data is stored in DIF, two different types of computers can exchange the data over communications lines (such as an RS-232 connection).

The DIF Format

DIF represents data in tables and provides for optional accompanying information that describes the data. Descriptive information can be associated with all of the data in the table or with a specific column. In table 1, for instance, the title "Profit Report" clearly refers to the whole table. The labels "Year," "Sales," "Cost," and "Profit," however, each refer to only one column of data. Programs can use the data values and ignore the title and labels if desired.

Because tables can be structured in many different ways, DIF uses the terms "vector" and "tuple" instead of "column" and "row." Each tuple in table 2 contains one data value from each vector. This example has three

PROFIT REPORT

Year	Sales	Cost	Profit
1980	100	90	10
1981	110	101	9
1982	121	110	11

Table 1: *A simple table projecting profits for the years 1980, 1981, and 1982.*

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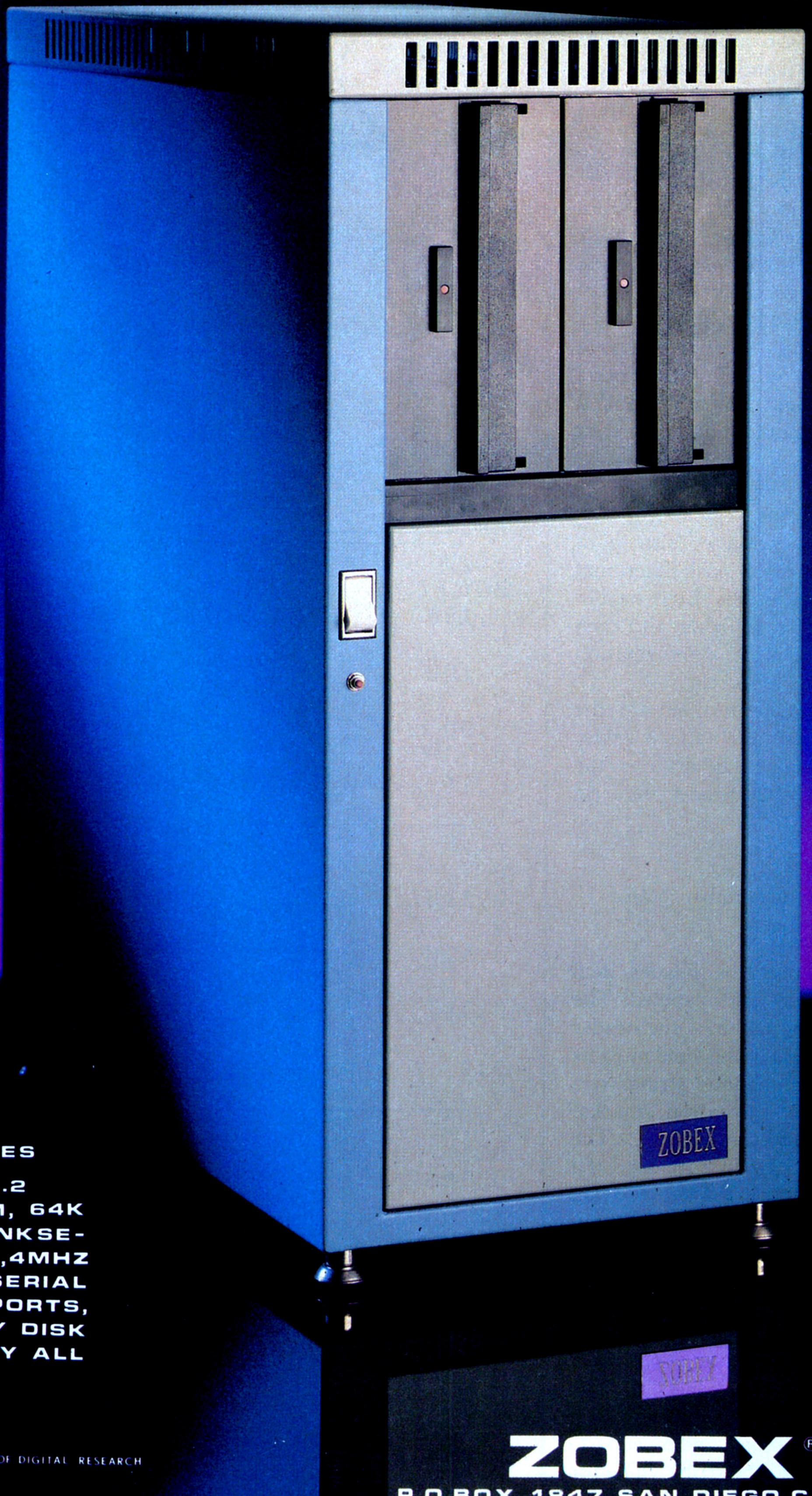

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tuples of four data values each:

1980,100,90,10
1981,110,101,9
1982,121,110,11

To keep the format simple, DIF requires that all the tuples in a table have equal length and that all the vectors have equal length.

The Structure of DIF

To illustrate the structure of DIF, we will show how DIF would store the data presented in table 1. Figure 1 shows the DIF file for the data in table 1, with large braces drawn to label various subdivisions of the file.

Every DIF file has two parts: a header section containing descriptive information about the table, and a data section containing the data values.

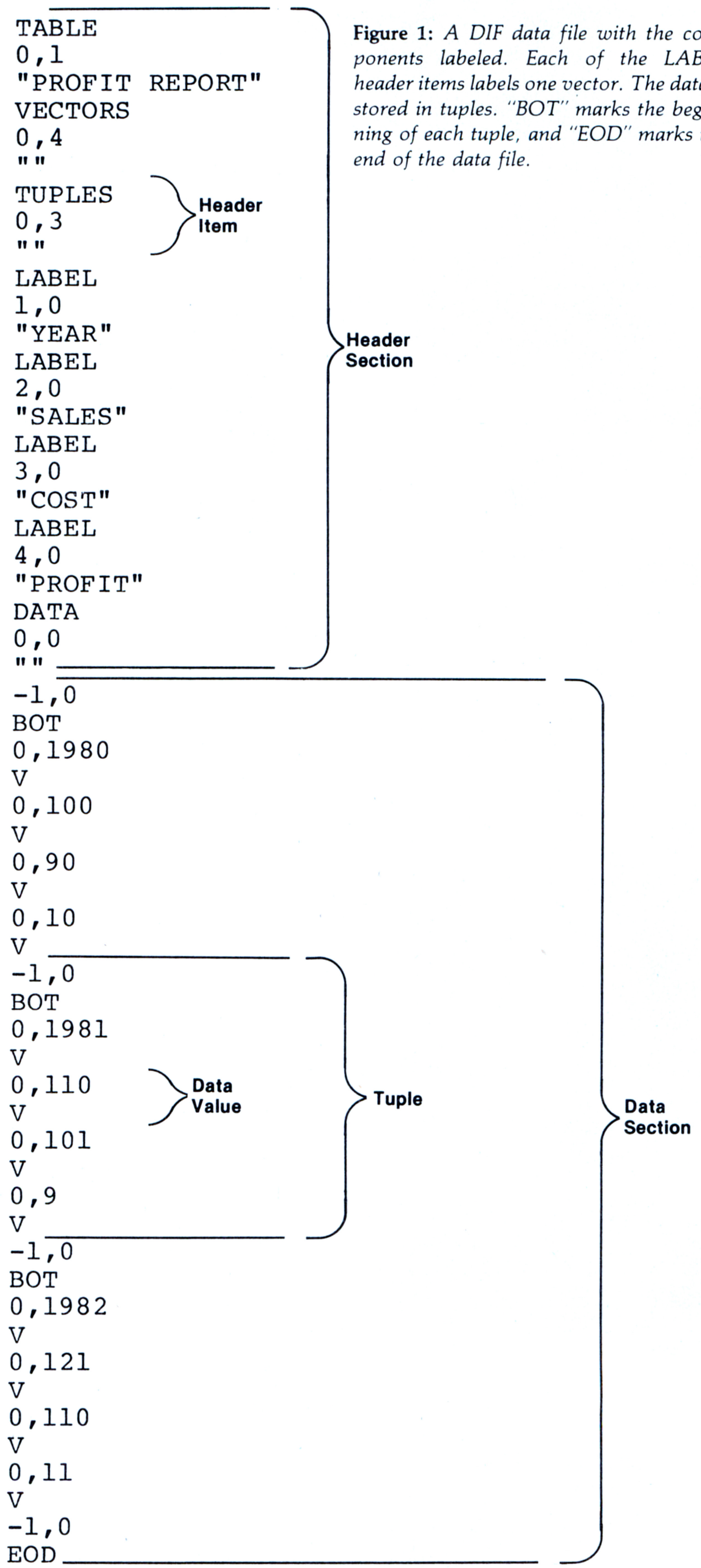
DIF Header Items

The header section consists of a series of header items, each describing one aspect of the file. Each header item consists of four fields, and each field contains a piece of information about the data-file format.

The fields in a header item are the topic, the vector number, the value, and the string value. DIF arranges the four fields of each header item on three lines:

Line 1 Topic
Line 2 Vector Number, Value
Line 3 "String"

Figure 2 shows the header item TABLE with the fields labeled. The topic field is the name of the header item; information in this field must be an uppercase alphabetic string with no spaces or quotation marks. TABLE is the topic in figure 2. The vector number, the first field on the second line, specifies the vector being referenced. Note, however, that if the header item does not belong to a single, specific vector, then the vector number used is 0. Since the header item TABLE refers to the entire file rather than to any single vector, TABLE's vector number is 0. The data value for the header item TABLE is the version number, and must be 1. On the third line, the string value for



```
TABLE
0,1
"PROFIT REPORT"
VECTORS
0,4
""
TUPLES
0,3
""
LABEL
1,0
"YEAR"
LABEL
2,0
"SALES"
LABEL
3,0
"COST"
LABEL
4,0
"PROFIT"
DATA
0,0
""
-1,0
BOT
0,1980
V
0,100
V
0,90
V
0,10
V
-1,0
BOT
0,1981
V
0,110
V
0,101
V
0,9
V
-1,0
BOT
0,1982
V
0,121
V
0,110
V
0,11
V
-1,0
EOD
```

Figure 1: *A DIF data file with the components labeled. Each of the LABEL header items labels one vector. The data is stored in tuples. "BOT" marks the beginning of each tuple, and "EOD" marks the end of the data file.*

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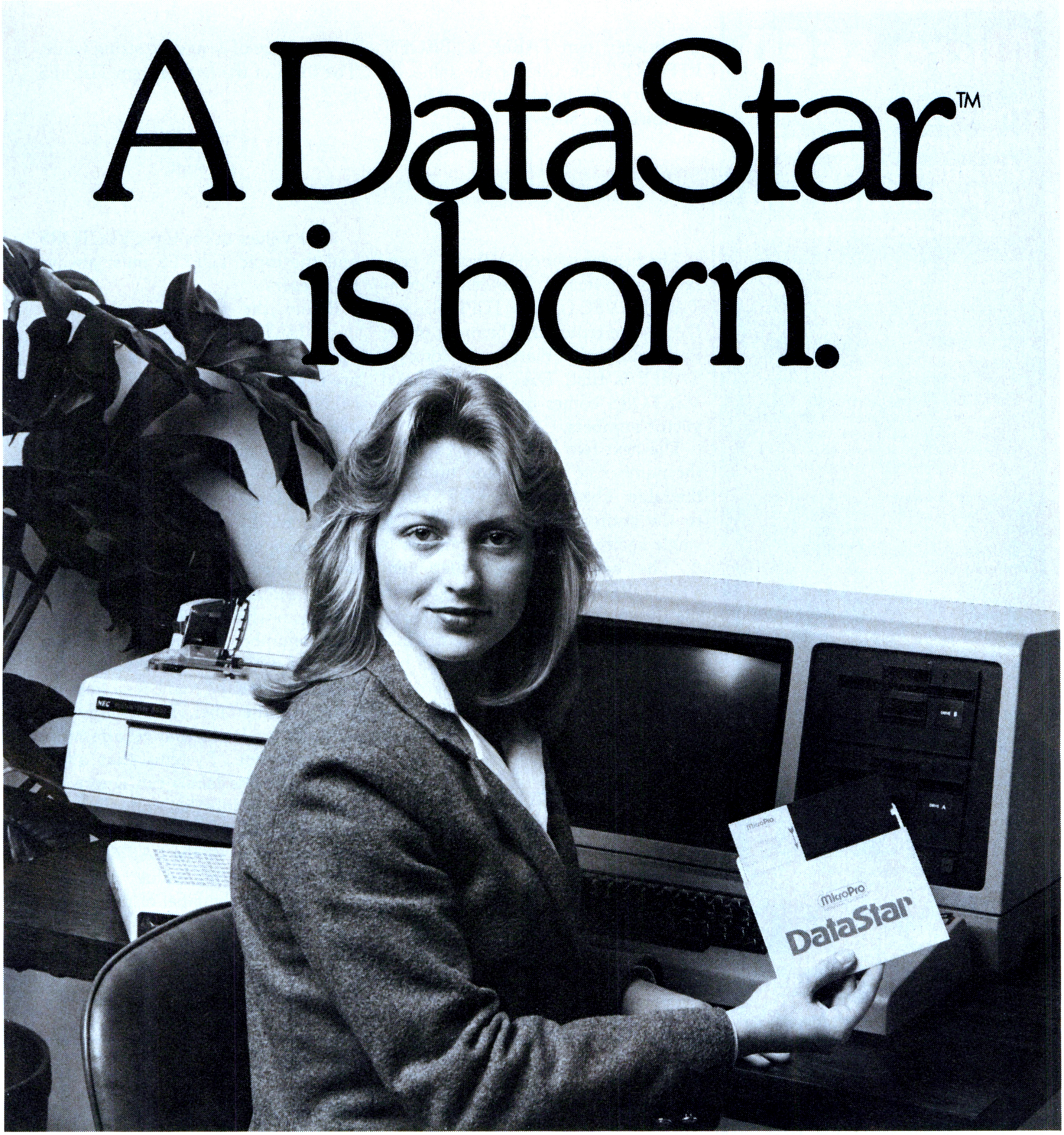

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the header item TABLE is "PROFIT REPORT," the title of the table. In summary, the header item TABLE is organized as follows:

TABLE
0,version#
"title"

The header section in figure 1 contains other items. The header items TABLE, VECTORS, TUPLES, and DATA are required. The order of the items does not matter, as long as TABLE is first, DATA is last, and VECTORS comes before any use of vector numbers.

The next two header items specify the number of vectors and tuples in the table. The topic VECTORS refers to the entire table rather than to a single vector, so the vector number is 0. The value of the header item VECTORS is the count of vectors in the file. Since the table has four columns, the data value of item VECTORS is 4. The item VECTORS has no string value, as shown by the empty pair of quotation marks. Thus, the header item VECTORS has the following form:

VECTORS
0,count
" "

Similarly, the header item TUPLES for our sample table has a vector of 0, a data value of 3, and no string value. The form of the header item TUPLES is:

TUPLES
0,count
" "

Data values of the topic VECTORS and the topic TUPLES must always be integers.

Before the last required header item, DATA, DIF permits standard optional header items. Among these are LABEL (described below), COMMENT, and SIZE. DIF also permits defining new header items to meet special needs. The DIF Technical Specification (available from the DIF Clearinghouse) describes in detail all the standard header items.

Looking again at figure 1, you can see that the header items whose topic is LABEL refer to specific vectors. Each item whose topic is LABEL has a vector number and may have a data value as well. The data value of a LABEL item is the number of lines required by the label. This is how DIF provides for labels that require more than one line. Systems that allow only single-line labels can ignore the line number. Note that under DIF, the values 0 and 1 are equivalent line numbers. Each of the LABEL header items has a string value, and that string value is the label of the vector.

	TABLE	←Topic
Vector Number →	0,1	←Value
	"Profit Report"	←String

Figure 2: *The organization of a DIF header item. The first line shows the topic. The second line shows the vector number and the value. Line 3 is the character string that is the header item's title.*

	Vector 1	Vector 2	Vector 3	Vector 4
Tuple 1	1980	100	90	10
Tuple 2	1981	110	101	9
Tuple 3	1981	121	110	11

Table 2: *A recasting of table 1 into DIF format, with tuples in place of rows, and vectors in place of columns.*

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Thus, the form of the header item LABEL may be represented as:

LABEL
vector#,line#
"label"

In figure 1, vector 1 is the column labeled "YEAR," vector 2 is the column labeled "SALES," vector 3 is the column labeled "COST," and vector 4 is the column labeled "PROFIT." Each label requires only one line, and so the data value is given as 0 (it could also be 1).

The last DIF header item must be DATA. It signals to the program that all items following are data values. A program can be structured to ignore all header items until it finds the DATA header item, which has the form:

DATA
0,0
" "

DIF Data Items

The form of data items differs from that of header items. DIF organizes data by tuples. Within the tuples, values are arranged according to the order of the vectors.

Each data entry consists of three fields on two lines. The first line contains two numeric values, which are respectively the type indicator and the number value. The second line contains only one value, the string value. Together the type indicator, the number value, and the string value represent one DIF data value, in the following form:

type indicator, number value
string value

The type indicator, which must be an integer, can have one of three possible values. A type-indicator value of 0 means the data is numeric and is stored in the field immediately following the type indicator. A type-indicator value of 1 means the data is a string. For string data, the number-value field is ignored and the string value is stored on the second line of the data item. Finally, a type-indicator value of −1 indicates a special data value. The number-value field is 0, and the string-value field may have one of two special values: BOT (beginning of tuple) or EOD (end of data). These are discussed further in the section on string-field values.

The Number Value. The number value may be signed (+ or −) and may contain a decimal point. One or more blanks may precede or follow the number value. If the data value contains an exponent of a power of ten, the value is followed by the letter "E" and the signed or unsigned exponent. The number value is the only place that DIF allows a noninteger value.

When the data value is numeric, the string-value field contains one of the values described in the following section.

The String Value. When the type-indicator is 1, the data is a string and contains no control characters and no quotation marks. If the string is a sim-

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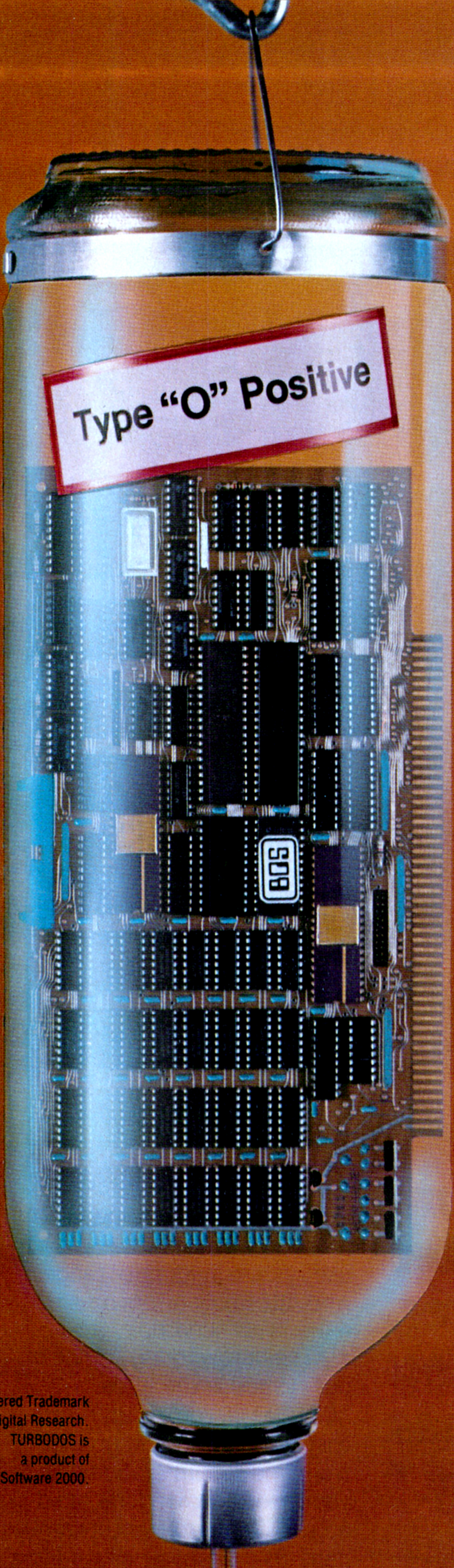

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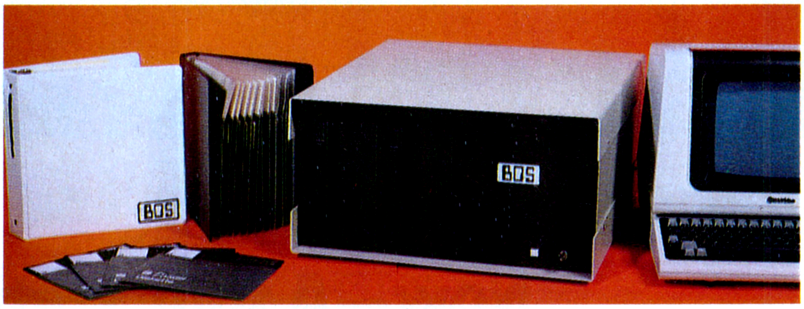

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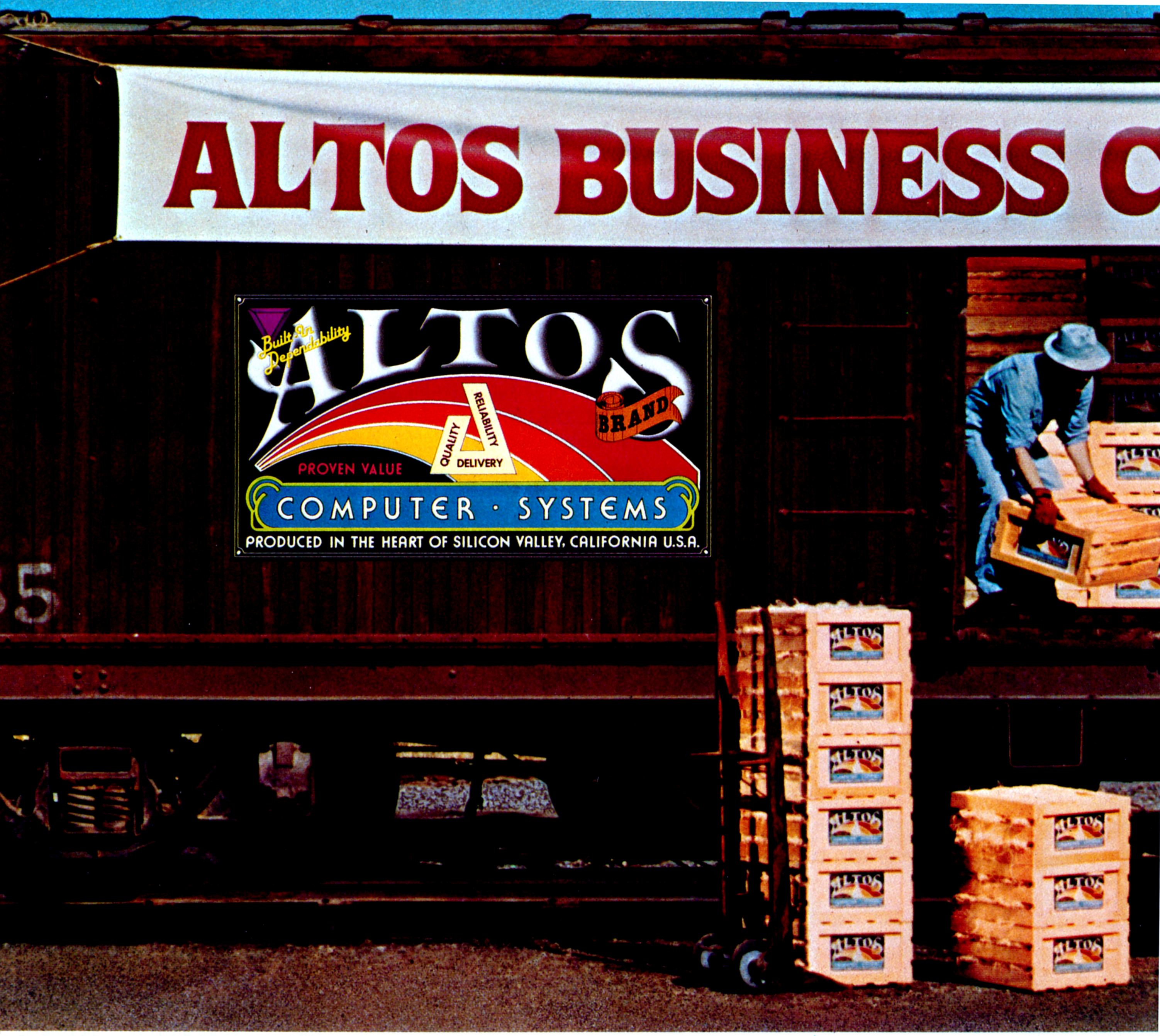
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ple word, it may be entered directly on the line. If the string contains blanks or special characters, then the string must be enclosed in quotation marks. If the string is null, the string-value field contains quotation marks with no space between them.

When data is numeric, the string value is one of the following uppercase, unquoted words:

V: indicates a numeric value.
NA: not available. Indicates that the value marked is not available; the number value is 0.
ERROR: the result of an invalid calculation; the number value is 0.
TRUE: the logical value; the number value is 1.
FALSE: the logical value; the number value is 0.

Special Data Values. If the type-indicator field is −1, then the data is one of two special data values, BOT or EOD. BOT flags the beginning of a tuple, and EOD flags the end of the last tuple in the file.

Sample Programs Using DIF

Listings 1 and 2 are BASIC programs that illustrate the use of DIF. Listing 3 is a Pascal program that shows a Pascal procedure to use a DIF file.

A teacher has written the program in listing 1 to create a DIF file that contains the names and tests scores of students. Because it is heavily commented, the program should not be difficult to follow. It prompts the teacher to enter a file name, the number of students, and the number of test scores for the students. The program organizes the data into one tuple for each student; a tuple consists of one string value for the student name and one numeric value for each test score. The number of vectors is one more than the number of test scores per student; the extra vector is for the student's name.

For example, if three test scores are entered for a student, there are four vectors, and a typical tuple might contain the following information:

Stephenson
75
82
60

This program enters student records into a file by prompting the

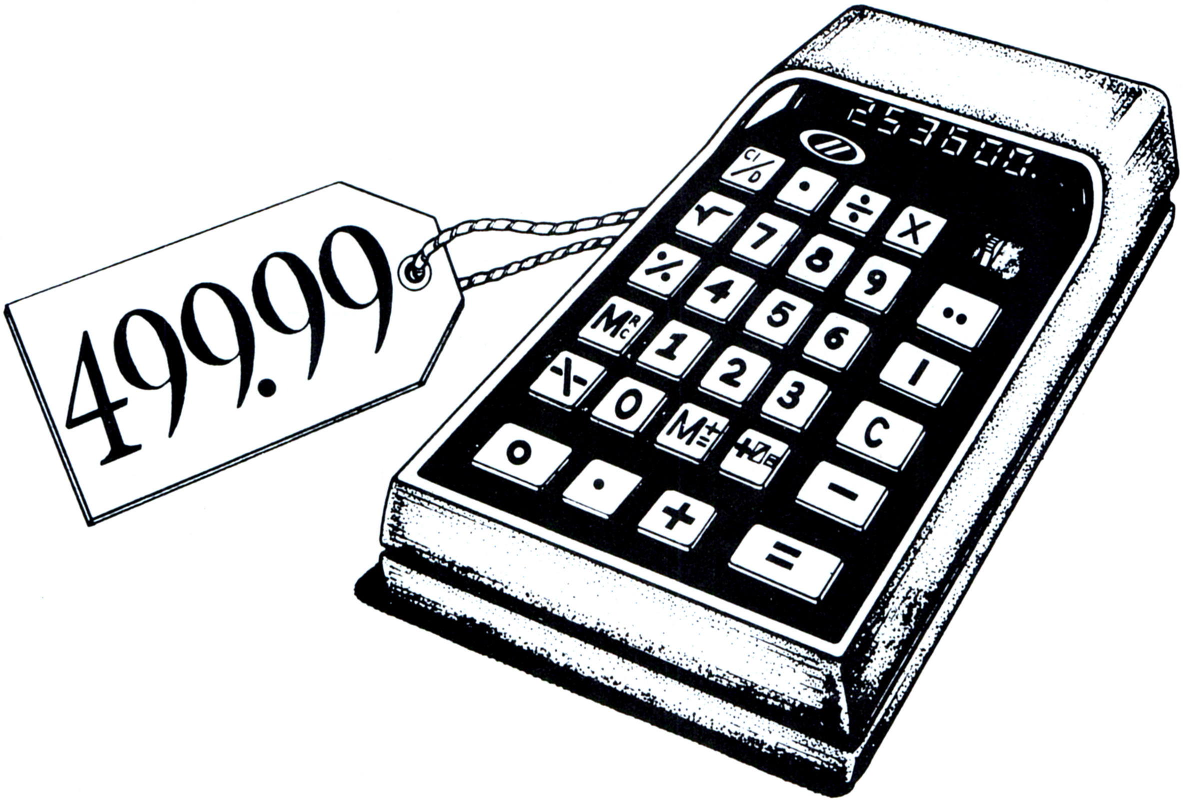
Text continued on page 206

Listing 1: *A BASIC program that uses DIF. This program prompts the user for a student's name and test scores and then copies the information into a DIF file.*

```
100 REM - THIS PROGRAM CREATES A DIF FILE CONTAINING THE
110 REM - NAME AND TEST SCORES OF A GIVEN NUMBER OF STUDENTS.
120 REM - IT PROMPTS FOR A FILE NAME, THE TOTAL NUMBER OF
130 REM - STUDENTS, AND THE NUMBER OF TEST SCORES FOR
140 REM - EACH STUDENT.  IT THEN PROMPTS FOR A STUDENT´S
150 REM - NAME AND TEST SCORES, AND WRITES THEM TO THE
160 REM - FILE AS A TUPLE.


1000 PRINT "OUTPUT FILE NAME:"; :REM - GET FILE NAME.
1010 INPUT F$
1020 OPEN "O",1,F$             :REM - OPEN FILE FOR OUTPUT.
1030 PRINT "NUMBER OF STUDENTS:";
1035                           :REM - PROMPT FOR NUMBER OF
1040 INPUT NT                  :REM -    TUPLES.
1050 PRINT "NUMBER OF TEST SCORES PER STUDENT:";
1060 INPUT NV                  :REM - NUMBER OF VECTORS IS
1070 NV = NV + 1               :REM -    NUMBER OF SCORES + 1.
1080 GOSUB 3000                :REM - USE SUBROUTINE TO
1090                           :REM -    OUTPUT DIF HEADER.
2000 FOR I = 1 TO NT           :REM - OUTPUT A TUPLE FOR
```

Listing 1 continued on page 188



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Listing 1 continued:

```
2010                             :REM -   EACH STUDENT.
2020    T = -1: V = 0: S$ = "BOT"
2025                             :REM - OUTPUT BOT SPECIAL
2030    GOSUB 4000               :REM -   DATA VALUE.
2040    PRINT "NAME OF STUDENT #";I;
2050    INPUT S$                 :REM - GET NAME OF THIS STUDENT.
2060    T = 1: V = 0             :REM - OUTPUT AS STRING DATA
2070    GOSUB 4000               :REM -   VALUE.
2080    FOR J = 1 TO NV-1        :REM - PROCESS EACH SCORE.
2090       PRINT "SCORE #";J;
2100       INPUT V               :REM - GET SCORE.
2110       T = 0: S$ = "V"       :REM - OUTPUT SCORE AS A DATA
2120       GOSUB 4000            :REM -   VALUE.
2130    NEXT J
2140 NEXT I
2150 T = -1: V = 0: S$ = "EOD"   :REM - OUTPUT EOD SPECIAL DATA
2160 GOSUB 4000                  :REM -   VALUE.
2170 CLOSE 1                     :REM - CLOSE THE OUTPUT FILE.
2180 STOP                        :REM - DONE.

3000                             :REM - ROUTINE TO OUTPUT HEADER.
3010 PRINT#1,"TABLE":PRINT#1,"0,1":GOSUB 3500
3020 PRINT#1,"TUPLES":PRINT#1,"0,";NT:GOSUB 3500
3030 PRINT#1,"VECTORS":PRINT#1,"0,";NV:GOSUB 3500
3040 PRINT#1,"DATA":PRINT#1,"0,0":GOSUB 3500

3050 RETURN
3500                             :REM - ROUTINE TO OUTPUT A
3510                             :REM -   NULL STRING ("").
3520 PRINT#1,CHR$(34);CHR$(34)   :REM - PRINT 2 QUOTATION MARKS.
3530 RETURN

4000                             :REM - ROUTINE TO OUTPUT A DATA
4010                             :REM -   VALUE.  T IS THE TYPE
4020                             :REM -   INDICATOR, V IS THE
```

Listing 1 continued on page 190

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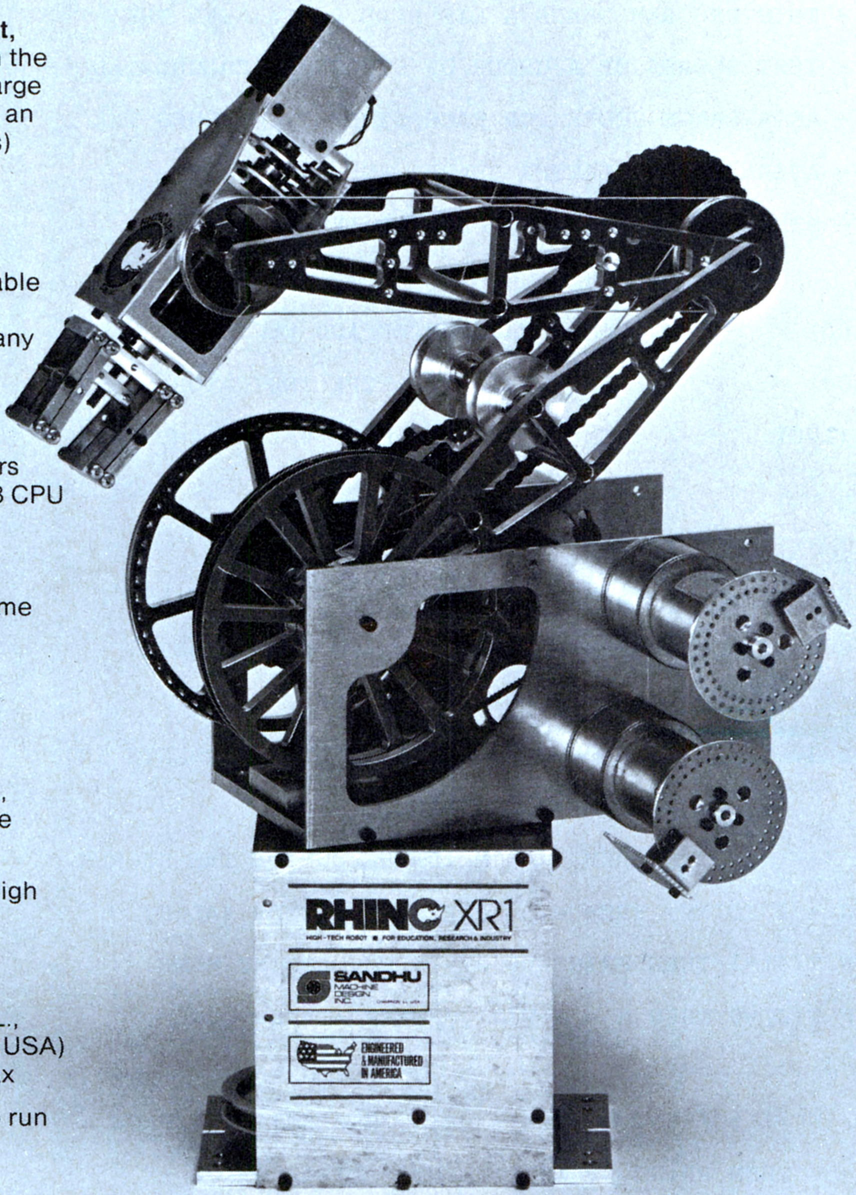
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Listing 1 continued:

```
4030                          :REM -    NUMBER VALUE, AND S$
4040                          :REM -    IS THE STRING VALUE.
4050 PRINT#1,T;",";V
4060 PRINT#1,S$
4070 RETURN
5000 END
```

Listing 2: *A BASIC program whose input is the DIF file created by the program in listing 1. This program calculates an average test score and a letter grade for each student.*

```
100    :REM - THIS PROGRAM READS A DIF FILE CONTAINING THE
110    :REM - TEST SCORES OF A GROUP OF STUDENTS, CALCULATES
120    :REM - AN AVERAGE SCORE FOR EACH STUDENT, MATCHES THE
130    :REM - AVERAGE TO A LETTER GRADE, AND PRINTS THE
140    :REM - STUDENT´S NAME, AVERAGE, AND LETTER GRADE.


500 DIM T(100)           :REM - MAXIMUM OF 100 VECTORS.
510 DIM V(100)           :REM - T IS THE TYPE INDICATOR, V IS
520 DIM V$ (100)         :REM -    THE NUMBER VALUE, AND V$ IS
530                      :REM -    THE STRING VALUE OF EACH DATA
535                      :REM -    VALUE.
540 GOSUB 5000           :REM - INITIALIZATION SUBROUTINE.
550 GOSUB 6000           :REM - SUBROUTINE TO READ HEADER.
560 FOR I = 1 TO NT      :REM - FOR EACH TUPLE,
570    GOSUB 7000        :REM -    GET ALL VECTOR ELEMENTS IN
575                      :REM -    TUPLE.
580    M=0               :REM -    M IS THE SUM OF THE SCORES.
590    FOR J = 1 TO NV   :REM -    FOR EACH VECTOR VALUE,
600       IF T(J)=1 THEN PRINT V$(J)   :REM - PRINT NAME.
610       IF T(J)=0 THEN M = M+V(J)    :REM - ADD SCORES.
620    NEXT J
630   M = M/(NV-1): PRINT M :REM - PRINT STUDENT´S AVERAGE
640   IF M<=50 THEN PRINT "THIS STUDENT´S FINAL GRADE IS F"
650   IF M<=70 AND M>50 THEN PRINT "THIS STUDENT´S FINAL GRADE IS D"
660   IF M<=85 AND M>70 THEN PRINT "THIS STUDENT´S FINAL GRADE IS C"
670   IF M<=94 AND M>85 THEN PRINT "THIS STUDENT´S FINAL GRADE IS B"
```

Listing 2 continued on page 192

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Circle 62 on inquiry card.

Listing 2 continued:

```
680   IF M>94 THEN PRINT "THIS STUDENT´S FINAL GRADE IS A"
690 NEXT I
700 CLOSE 2
710 PRINT "FINISHED CALCULATING GRADES"
720 STOP

5000                       :REM - INITIALIZATION CODE.
5010 PRINT "FILE NAME";
5020 INPUT F$
5030 OPEN "I",2,F$         :REM - OPEN FILE FOR INPUT.
5040 NV = 0                :REM - INITIAL VECTOR COUNT.
5050 NT = 0                :REM - INITIAL TUPLE COUNT.
5060 RETURN
6000   :REM - READ HEADER. GET NUMBER OF VECTORS AND TUPLES.
6010 INPUT#2,T$            :REM - GET TOPIC.
6020 INPUT#2,S,N           :REM - GET VECTOR NUMBER AND VALUE.
6030 INPUT#2,S$            :REM - GET STRING VALUE.
6040 IF T$="VECTORS" THEN 6500:REM - CHECK FOR KNOWN HEADER
6050 IF T$="TUPLES" THEN 6600 :REM -    ITEMS.
6060 IF T$="DATA" THEN RETURN
6065                       :REM - "DATA" ENDS HEADER.
6070 GOTO 6010             :REM - IGNORE UNKNOWN ITEMS.
6500 NV = N                :REM - NUMBER OF VECTORS.
6510 IF NV<=100 THEN 6010 :REM - CHECK FOR 100 OR LESS VECTORS.
6520 PRINT "TOO MANY VECTORS. PROGRAM CAPACITY 100 VECTORS."
6530 CLOSE 2
6540 STOP
6600 NT = N                :REM - NUMBER OF TUPLES.
6610 GOTO 6010             :REM - GET NEXT HEADER ITEM.

7000   :REM - SUBROUTINE TO GET ALL VECTOR ELEMENTS IN A TUPLE.
7010 GOSUB 8000            :REM - GET NEXT DATA VALUE.
7020 IF T1<>-1 THEN 9000 :REM - MUST BE BOT, ELSE ERROR
7030 IF S$<>"BOT" THEN 9000
```

Listing 2 continued on page 194

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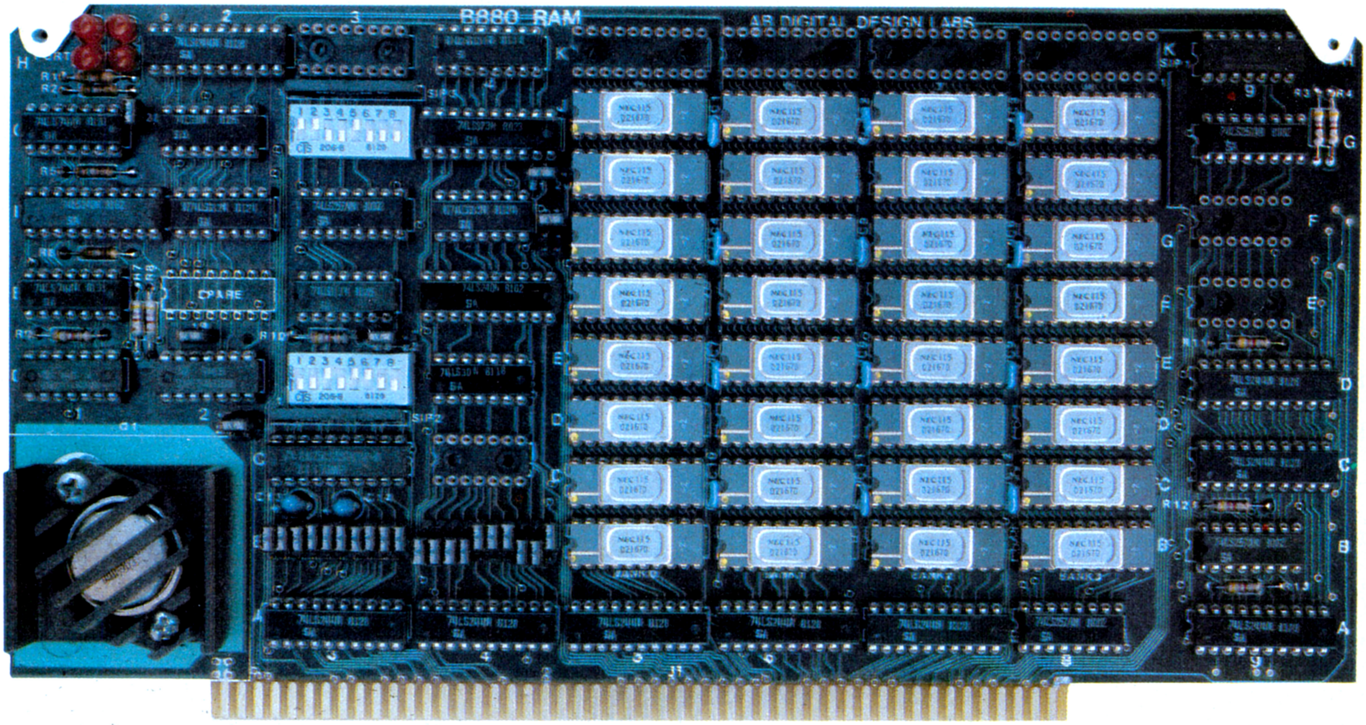

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Circle 2 on inquiry card.

Listing 2 continued:

```
7040   FOR K = 1 TO NV :REM - GET EACH DATA VALUE.
7050      GOSUB 8000
7060      IF T1>1 THEN 9000
7070      T(K) = T1     :REM - SAVE TYPE INDICATOR.
7080      V(K) = V1     :REM - SAVE NUMBER VALUE.
7090      V$(K) = S$    :REM - SAVE STRING VALUE.
7100      NEXT K
7110 RETURN

8000    :REM - SUBROUTINE TO GET NEXT DATA VALUE.
8010 INPUT#2,T1,V1      :REM - GET TYPE INDICATOR, NUMERIC
8020 INPUT#2,S$         :REM -    VALUE, AND STRING VALUE.
8030 RETURN

9000    :REM - ERROR ROUTINE
9010 PRINT "ERROR IN FILE FORMAT"
9020 CLOSE 2            :REM - END PROGRAM
9030 STOP
9040 END
```

Listing 3: *A Pascal program that reads data from a DIF file into an array and then displays the data on the terminal. The variant of Pascal used is Apple Pascal 1.1.*

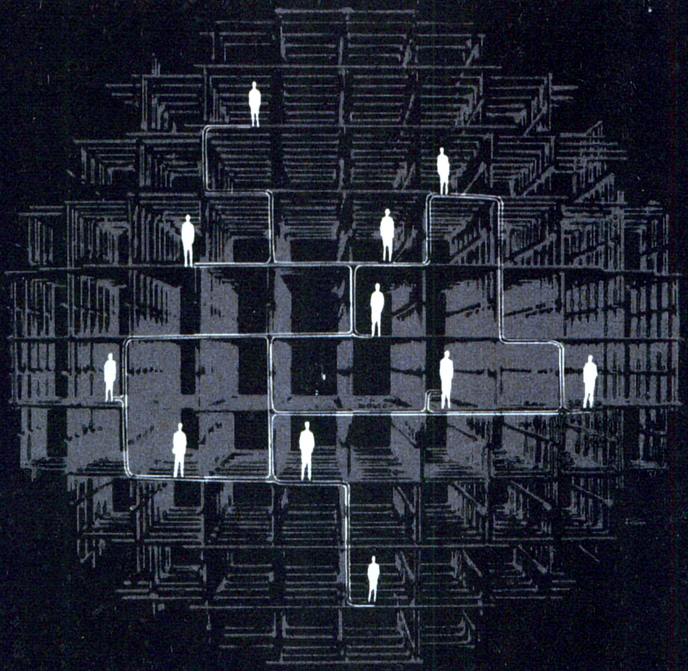
```
{ This is a simple program which reads DIF file data into an array and
  displays the results on the terminal.  It makes use of a procedure
  called "get_dif_array" which handles only numeric data.  It is written
  for Apple Pascal 1.1 and may require modification to run on other systems. }

program dif_read;

const
   max_vector =  10;                       { maximum number of vectors }
   max_tuple  =  10;                       { maximum number of tuples }

type
   vector_index = 0..max_vector;
```

Listing 3 continued on page 196



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Listing 3 continued:

```
   tuple_index    = 0..max_tuple;
   dif_array      = array[1..max_vector, 1..max_tuple] of real;


var
   in_file      : text;                num_vectors : vector_index;
   fname        : string[15];          num_tuples  : tuple_index;
   matrix       : dif_array;           code, i, j  : integer;



{ "Get_dif_array" reads a DIF file and returns the file data (currently
  only numeric) in an array.  Also returns number of vectors and tuples
  -- these must be specified in file header -- and an error code. }


procedure get_dif_array (var dif_file: text; var real_array: dif_array;
                         var nvectors: vector_index; var ntuples: tuple_index;
                         var return_code: integer);


   const                                          { currently defined data types }
      special = -1; numeric =  0; char_string  =  1; other   =  2;


   type
      header_item   = record
                        topic        : string;
                        vector_num   : vector_index;
                        value        : integer;
                        string_value : string
                      end;

      data_value    = record
                        kind         : -1..2;    { currently defined data types }
                        number_value : real;
                        string_value : string
                      end;


   var
      hdr_item        : header_item;
```

Listing 3 continued on page 198

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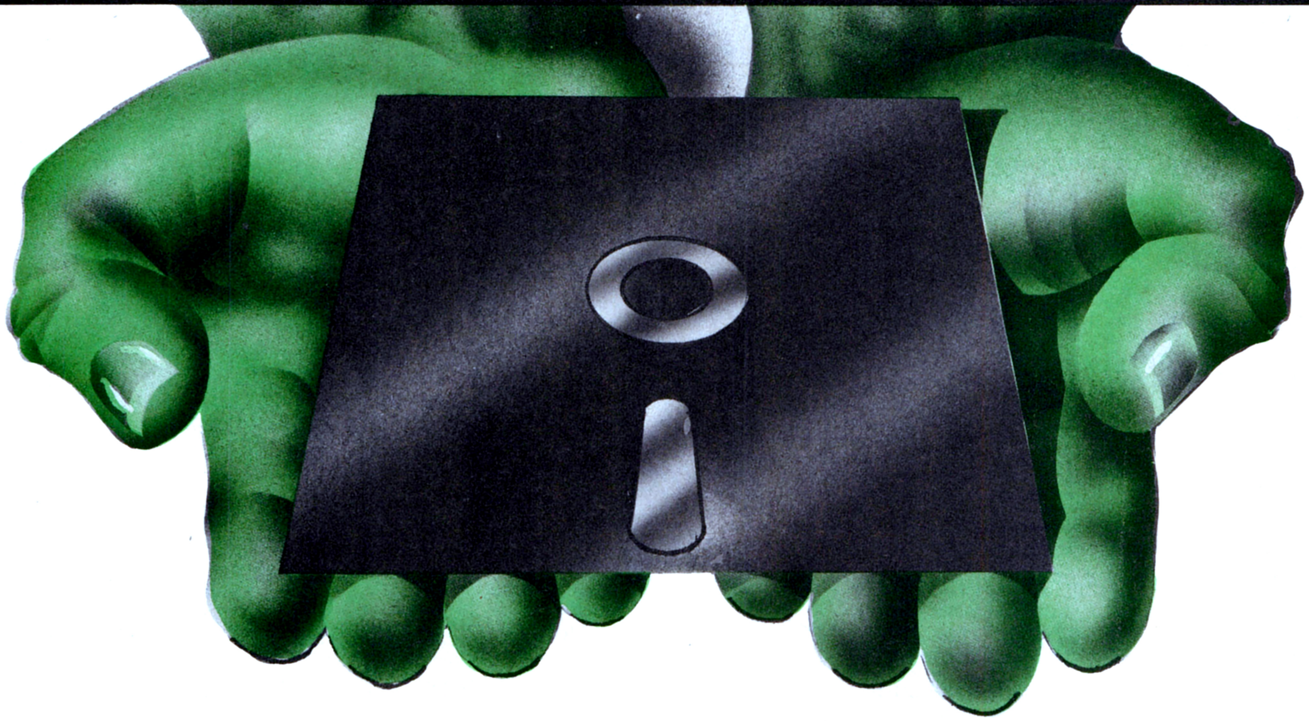

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Circle 425 on inquiry card.

Listing 3 continued:

```
    data_val      : data_value;
    tuple, vector : integer;

{ "Read_integer" reads an integer terminated with a comma.  The routine
  is required because this Pascal dialect´s "read" procedure recognizes
  only <space>, eoln and eof as delimiters of integer values. }

procedure read_integer (var number: integer);
   var
      sign, magnitude : integer;
      ch : char;
   begin
      sign := 1;  magnitude := 0;              { initialize }
      read (difile, ch);                       { get 1st character }
      while ch <> ´,´ do                       { comma is delimiter }
         begin
            case ch of
              ´-´ : sign := -1;
              ´0´,´1´,´2´,´3´,´4´,´5´,´6´,´7´,´8´,´9´
                  : magnitude := magnitude * 10 + ord(ch) - ord(´0´)
            end;  { case }
            read (difile, ch)                  { get next character }
         end;
      number := sign * magnitude               { return result }
   end;  { read_integer }

{ "Read_string"  deletes leading and trailing blanks and strips the
  quotes from quoted strings. }

procedure read_string (var str: string);
   begin
      readln (difile, str);
      while str[1] = ´ ´ do                             { leading blanks }
         delete (str, 1, 1);
      if str[1] = ´"´                                   { strip quotes }
```

Listing 3 continued on page 200

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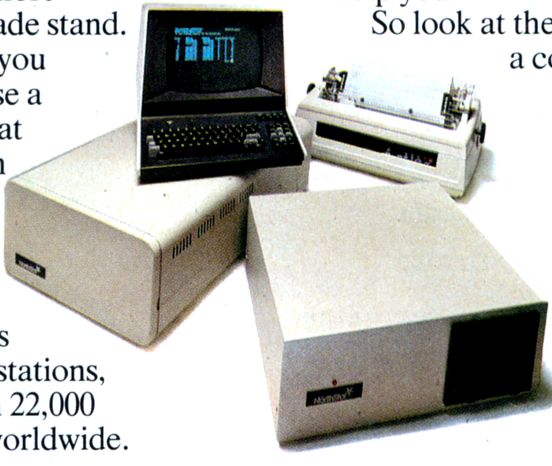

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Circle 307 on inquiry card.

Listing 3 continued:

```
         then begin
                delete (str, 1, 1);
                delete (str, pos('"', str), length(str) - pos('"', str) + 1)
              end
      else if pos(' ', str) > 0                          { trailing blanks }
         then delete (str, pos(' ', str), length(str) - pos(' ', str) + 1)
   end;  { read_string }


procedure read_header_item (var item: header_item);
   begin
      read_string (item.topic);                          { get topic }
      read_integer (item.vector_num);                    { get vector number }
      readln (difile, item.value);                       { get value }
      read_string (item.string_value)                    { get string value }
   end;   { read_header_item }


procedure read_data_value (var value: data_value);
   begin
      read_integer (value.kind);                         { get data type }
      readln (difile, value.number_value);               { get number value }
      read_string (value.string_value)                   { get string value }
   end;   { read_data_value }


begin   { get_dif_array }
   return_code := 0;                                     { assume no problems }
   nvectors := 0; ntuples := 0;                          { initialize }
   repeat                                                { read header }
      read_header_item (hdr_item);
      if hdr_item.topic = 'VECTORS'
         then nvectors := hdr_item.value                 { vector count }
      else if hdr_item.topic = 'TUPLES'
         then ntuples := hdr_item.value                  { tuple count }
   until hdr_item.topic = 'DATA';

   if (nvectors = 0) or (ntuples = 0)                    { check counts }
```

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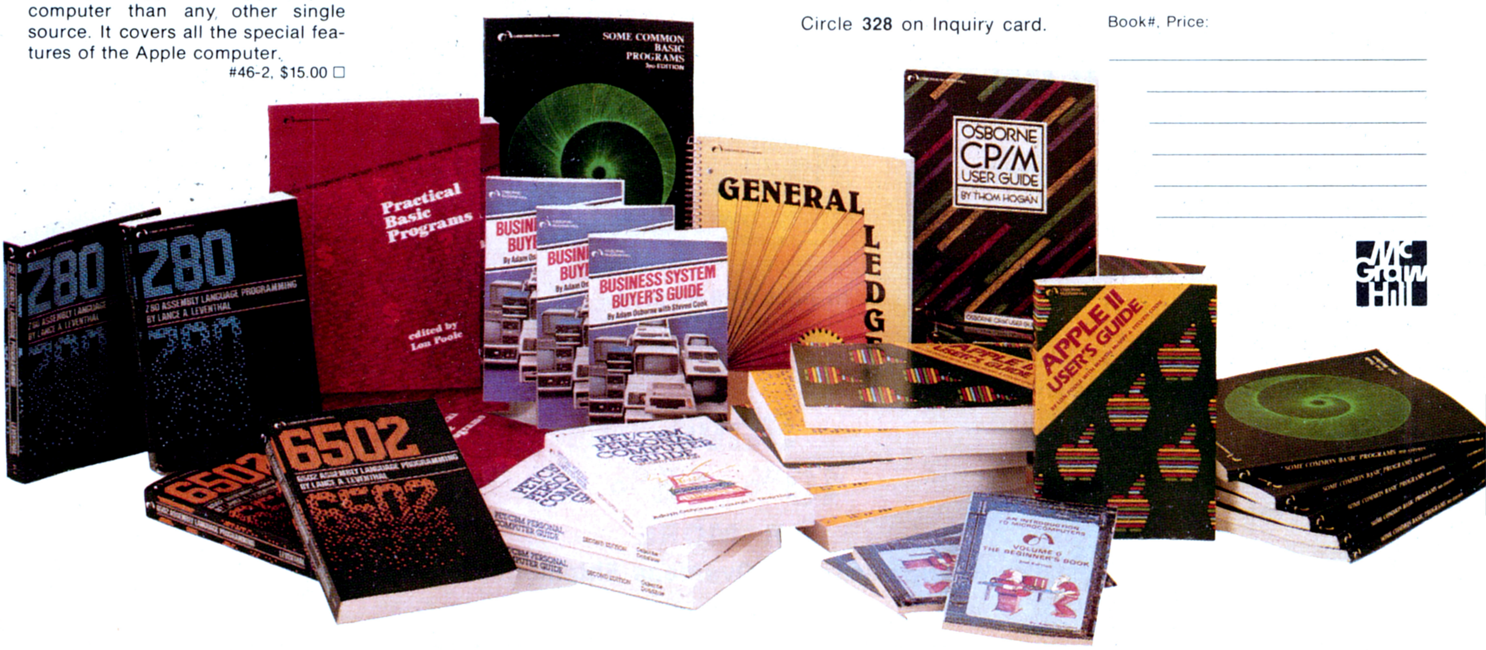
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Listing 3 continued:

```
    then return_code := 1

    else begin

        for tuple := 1 to ntuples do                    { read data }

          begin

            read_data_value (data_val);                     { BOT }

            for vector := 1 to nvectors do

              begin

                read_data_value (data_val);

                if data_val.kind = numeric

                  then real_array[vector, tuple] := data_val.number_value

              end

          end;

        read_data_value (data_val);                         { EOD }

        if (data_val.kind <> special) or

           (data_val.string_value <> ´EOD´)

           then return_code := 2

        end
```

Listing 3 continued on page 204

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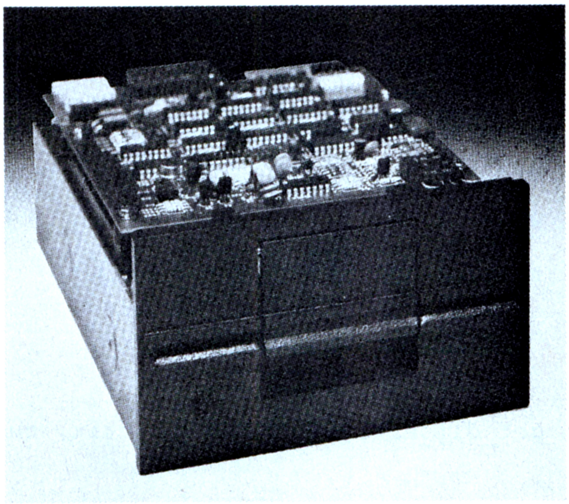

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Qume's independent head load yields wear characteristics far superior to competitive drives. This superior wear performance produces savings on both diskette usage and drive maintenance.

Improved data reliability, resulting from superior amplitude and bit shaft characteristics, optimizes operator efficiency and reduces processing time for end-users.

And Data Trak's unique modular design means simplified field servicing for you and your customers.

Design Features

Expanded storage capacity • Two-sided, double-density

Proven head carriage assembly • Ceramic head with tunnel erase • Dual-head flex mounting arrangement • Superior head load dynamics

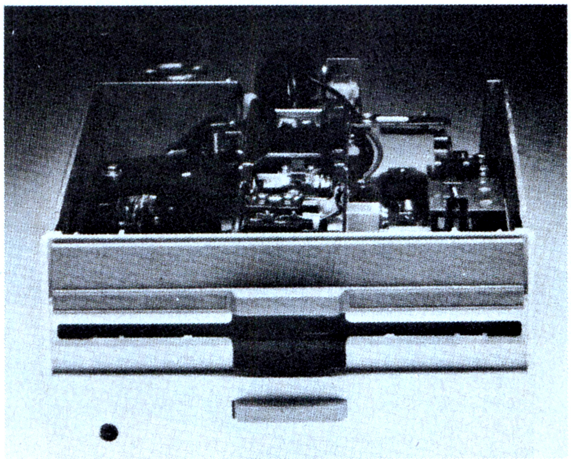
Precise lead screw actuator • Fast access time — 12 ms track-to-track • Low friction and minimum wear • Low power dissipation

Additional features • Industry standard 5¼" media format • ISO standard write protect • Door lock out for media protection • Requires DC voltage only • Daisy Chain up to 4 drives • Heads load on command independent of loading media

Product Specifications

Performance Specifications • Capacity: Unformatted: 437.5K or 500K bytes; Qume Formatted: 286.7K or 327.7K bytes • Recording Density: 5456 BPI • Track Density: 48 TPI • Cylinders: 35 or 40 • Tracks: 70 or 80 • Recording Method: FM or MFM • Rotational Speed: 300 RPM • Transfer Rate: 250K bits/second • Latency (avg.): 100 ms • Access Time: Track-to-track 12 ms; Settling 15 ms • Head Load Time: 50 ms

---



The Data Trak™ 8

double-sided double-density drive uses state-of-the-art technology to give you superior data integrity through improved disk life, data reliability, and drive serviceability.

Qume's innovative approach to controlling head load dynamics yields wear characteristics far superior to competitive drives. In independent evaluation, Data Trak 8 is setting industry standards for tap test performance. This superior wear performance produces savings on both diskette usage and drive maintenance.

Improved data reliability, resulting from superior amplitude and bit shift characteristics, optimizes operator efficiency and reduces processing time for end-users.

And Data Trak's unique modular design means simplified field servicing for you and your customers.

Design Features

Expanded storage capacity • Two-sided, double-density

Fully IBM compatible • IBM 3740 and System 32 drives • IBM 3600 and 4964 drives • IBM System 34 drives

Proven head carriage assembly • Ceramic head with tunnel erase • Dual-head flex mounting arrangement • Superior head load dynamics

Fast, precise steel belt drive • Fast access time — 3 ms track-to-track • Low friction and minimum wear • Low power dissipation

Additional features • ISO standard write protect • Programmable door lock • Negative DC voltage not required • Daisy Chain up to 4 drives • Side-by-side mounting in standard 19" RETMA rack • Compatible with Shugart SA850/SA851

Product Specifications

Performance Specifications • Capacity: Unformatted: 1.6 Mbytes/disk; IBM Format: 1.2 Mbytes/disk • Recording Density: 6816 BPI • Track Density: 48 TPI • Cylinders: 77 • Tracks: 154 • Recording Method: MFM • Rotational Speed: 360 RPM • Transfer Rate: 500Kbits/second • Latency (avg.): 83 ms • Access Time: Track-to-track 3 ms; Settling 15 ms; Average 91 ms • Head Load Time: 35 ms • Disk: Diskette 2D or equivalent

---

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Circle 471 on inquiry card.

Listing 3 continued:

```
   end;  { get_dif_array }



begin    { dif_read }

   writeln;                                    { get DIF file name }
   write ('DIF file name: ');
   readln (fname);
   reset (in_file, fname);                     { open and point to BOF }

   get_dif_array (in_file, matrix, num_vectors, num_tuples, code);

   close (in_file);                            { close DIF file }
   case code of                                { display results }
     0: begin
          writeln;
```

Listing 3 continued on page 206

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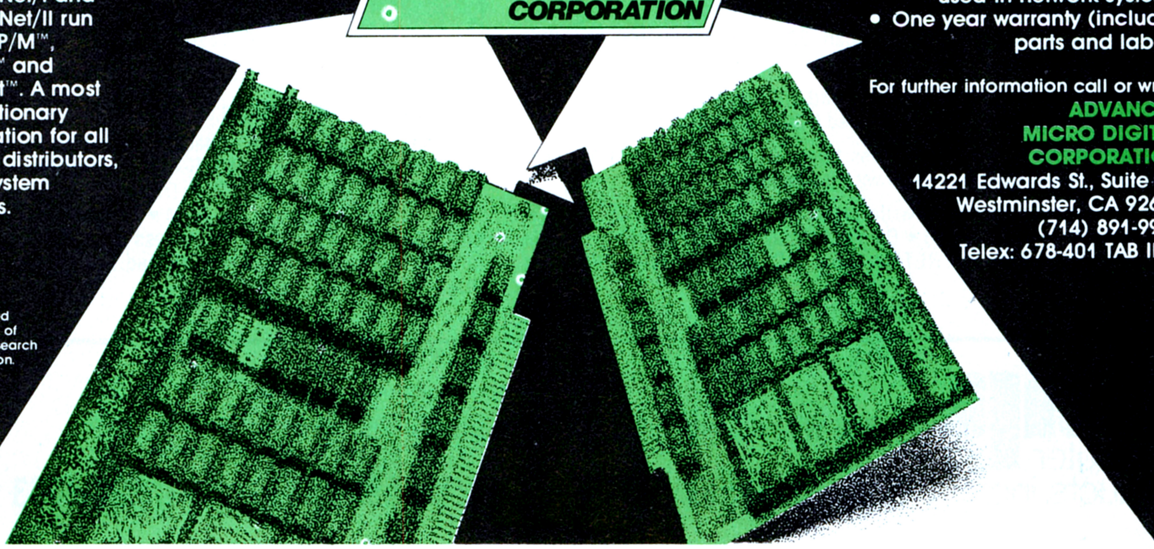

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- Floppy disk controller for 8-inch or 5 ¼-inch drives
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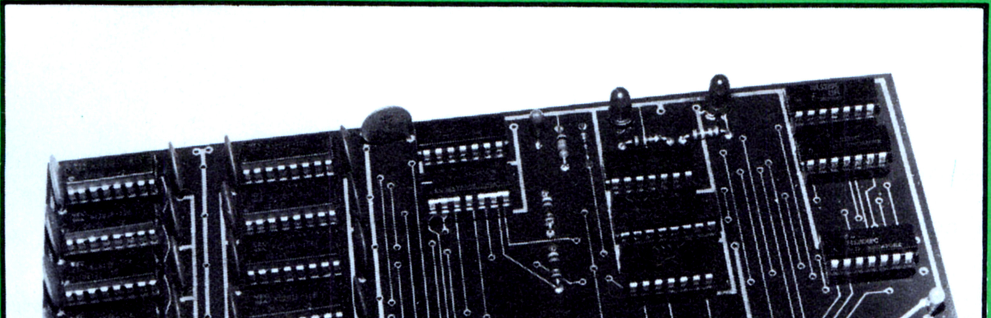

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CP/M is a trademark of Digital Research.

Circle 109 on inquiry card.

Listing 3 continued:

```
          writeln ('"', fname:15, '"', ' contains ', num_vectors:3,
                   ' vectors and ', num_tuples:3, ' tuples.');
          writeln ('The data values follow in tuple order:');
          writeln;
          for i := 1 to num_tuples do
             begin
               for j := 1 to num_vectors do
                  write (matrix[j, i]:10:2);
               writeln
             end;
          writeln
        end;
     1: writeln ('Error. Tuple or vector count not found.');
     2: writeln ('Error. Data not properly terminated.')
     end   { case }

end.  { dif_read }
```

Text continued from page 186:

user for a student's name and test scores, and then copying the information into a DIF file.

Listing 2 takes the output DIF file from listing 1 and calculates an average score for each student and a letter grade for each student. Then the program prints the name, average, and letter grade for each student.

Listing 3, in Pascal, reads data from a DIF file into an array and displays the data on a terminal.

A close look at these listings will convince you that using DIF can simplify many programming tasks. Whatever your favorite programming language, try using the DIF format when you write your next program. You'll find the format convenient and clear, and you may make your program attractive to a large body of software users who have already stored much of their essential data in the DIF format. The accompanying text box tells you how to obtain additional information about joining the community of programmers who use DIF. ■

For Further Information about DIF

The DIF Clearinghouse coordinates and distributes information about DIF and commercially available programs that use DIF. For information, send a request to the DIF Clearinghouse, POB 527, Cambridge MA 02139. Include $6.00 along with your name, address, and ZIP code.

The DIF Clearinghouse will send you the DIF Technical Specification, providing a more detailed description of the DIF format, as well as current information about programs that support DIF. The clearinghouse will also send you any updates published during the following year.

The clearinghouse would like to add to its growing list of programs that support DIF. No royalties or fees are charged for using DIF, but the clearinghouse does make three requests of authors of commercially available programs that use DIF.

First, please send a one-page description of your program to the DIF Clearinghouse. Describe what the program does, what computers it runs on, how it uses DIF, and how it can be purchased.

Second, because DIF is a trademark of Software Arts Inc, the "tm" designation must be used if DIF is mentioned in any material you publish about your program. The material also should include the statement "DIF is a trademark of Software Arts Inc."

Finally, if you are unable to test your program with the VisiCalc program, please write the DIF Clearinghouse before advertising your product as supporting DIF. Any program employing DIF should be capable of transferring data to and from the VisiCalc program.

Circle 407 on inquiry card. →

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A Survey of Data-Base Management Systems for Microcomputers

Kathryn S Barley
DataWise
POB 426
Windermere FL 32786

James R Driscoll
Department of Computer Science
University of Central Florida
Orlando FL 32816

Advertisements for data-base management systems (DBMSs) seem more numerous all the time. At first glance, you would expect the advertised systems to perform similar functions. Yet, their prices range from $15 to $1500. What justifies such a price range? What functions do each of these systems actually perform? Some of them claim to solve almost every problem facing businesses and individuals today. Which problems *will* the available DBMSs solve? Most of the DBMSs available for large computers have principal goals of providing data integrity, data security, and data independence. Do the DBMSs available for microcomputers meet these same goals?

To answer these questions, we requested information from forty-eight companies that had advertised a DBMS for microcomputers. Our goal was not to judge systems against any preconceived DBMS standard, but rather to develop an overview of each system based on its user manual and compare all the systems feature by feature.

Eighteen companies sent us a user manual, and several included a disk of software as well. The text box on this page lists the names and addresses of these companies with the names of the products.

General Features

Table 1 lists some important general features of the twenty DBMSs, including hardware requirements, prices, available extension packages, type of data organization, method by which the user enters commands, and language in which the software is

Company	Product
Apple Orchard 131 Highland Ave Vacaville CA 95688	The Informer
Business Computer Services Co 9020 EBY Overland Park KS 66212	Data Handler
Condor POB 8310 Ann Arbor MI 48104	Condor Series 20/DBMS
Cromemco 280 Bernardo Ave Mountain View CA 94040	Cromemco Data Base Management System
Des Moines Computer 4456 Parklawn Dr Des Moines IA 50321	Micro Manager
High Technology POB 14665 Oklahoma City OK 73113	Information Master
Innovative Software 9805 Holly Kansas City MO 64114	Total Information Management—TIM
Jini Micro-Systems Inc POB 274-K Bronx NY 10463	Jinsam 2.0
Ken Knecht 6 South St, Box 68 Milford NH 03055	Dynamic Data Base
Micro AP 9827 Davona Dr San Ramon CA 94583	Selector IV
Micro Architect 96 Dothan St Arlington MA 02174	Interactive Data Manager—IDM-IV, IDM-M2
Microcomputer Technology Inc 3304 W MacArthur Santa Ana CA 92704	The Microconductor
Micro Data Base Systems, Inc POB 248 Lafayette IN 47902	MDBS
Muse 330 N Charles St Baltimore MD 21201	Micro Information System
Personal Software Inc 1330 Bordeaux Dr Sunnyvale CA 94086	CCA Data Management System
Radio Shack 700 One Tandy Ctr Ft Worth TX 76102	Profile Profile II
Systems Plus 1921 Rock St Suite 2 Mountain View CA 94043	The File Management System—FMS-80
The Bottom Shelf POB 49104 Atlanta GA 30359	Data Manager

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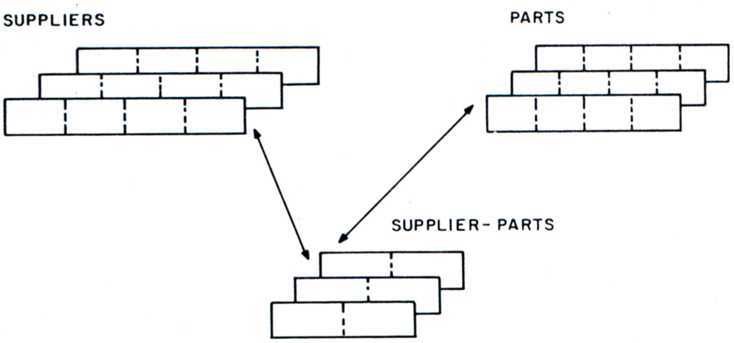


Figure 1: *A visual representation of files in a network data-base management system. The user can move through the network of files. For example, a user positioned at part number 124 in the Parts file can find out all the suppliers of that part by moving through the Supplier-Parts file to the Suppliers file.*

written. The table groups the systems by the kinds of computers on which they run, with the group that runs on the greatest number of computers listed first. With the exception of Condor and Microconductor, all the systems that cost more than $250 will in principle run on any popular small computer. However, requirements for specific hardware (for example, an 8-inch disk drive) or a specific operating system (such as CP/M) may in some cases prevent these DBMSs from running on the smallest model of some personal computers.

Most of the items in table 1 are easy to interpret, but a few require comment.

The extension packages listed in column 8 fall into three categories:

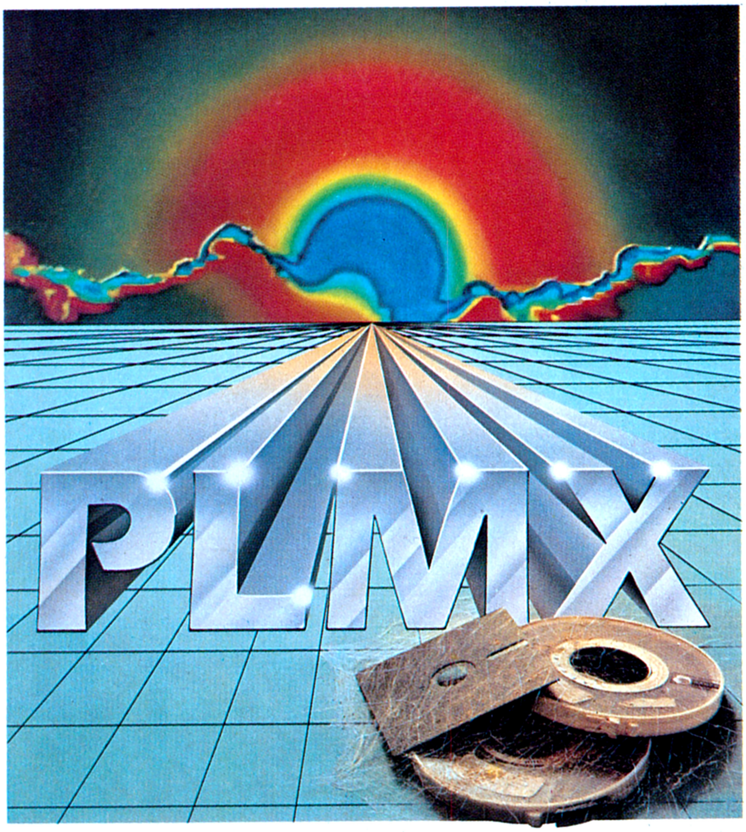
- word processors
- utility programs; for example, programs that rearrange a user's data to conform to a new definition
- statistical packages

We found no extension packages available for applications such as general ledger, inventory, or appointment scheduling, whether in the form of separate programs that use the DBMS's files or batch-command files for use within the system.

In the ninth column, headed Type, the systems that are simplest to understand are the type "file." All the records that can be used at the same time will belong to just one file, and that file constitutes the data base. For example, you might have one file that contains many records, and each of these records could consist of a supplier number, supplier name, address, and phone number.

Type "multifile" systems allow the use of more than one file. A data base of this type could include a file on suppliers, and a second file of records on parts. Each part record could contain a part number, part name, quantity on hand, and quantity on order. To indicate where each part comes from, a third file could be used as a cross-reference. Each record in this third file would contain a supplier number and part number.

A system of the type "relational"



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	Runs On	5-inch Disks	8-inch Disks	Hard Disk	Maximum # Disks	Minimum Memory	Price	Extension Packages/Price	Type	Command Entry Method	Language
MDBS	1	Y	Y	Y	8	?	$900	RTL QRS/$600 DRS	Network	Type Out	Machine language
FMS-80	2	–	Y	–	16	48 K	$750	–	Multifile	Menu and Type Out	Machine language
Selector IV	2	–	Y	Y	Comb	48 K	$550	–	Multifile	Menu and Type Out	CBASIC
TIM	2	Y	Y	Y	Comb	48 K	$400	WordStar	File	Menu	Microsoft BASIC
Condor	3	Y	Y	–	4	64 K	$695	–	Relational	Type Out	Z80 Machine language
Data Handler	4	Y	–	–	2	32 K	$ 25	–	File	Menu	Applesoft BASIC Commodore BASIC
CCA	5	Y	–	–	?	32 K	$100	–	File	Menu	Machine language
Microconductor	5	Y	–	–	?	32 K	$400	–	File	Menu and Type Out	–
Information Mstr	6	Y	–	–	2	48 K	$150	Data Master/$100	File	Menu	Applesoft BASIC
The Informer	6	Y	–	–	2	16 K	$ 50	–	File	Menu	–
Micro Info Sys	6	Y	–	–	2	48 K	$100	–	File	Menu	Applesoft BASIC
Jinsam 2.0	7	Y	–	–	?	24 K	$195	Mathpack/$40 Statpack/$50 Wordpack/$50 Label Gen/$50	File	Menu	Commodore BASIC; sorts and inputting in machine language
Cromemco	8	Y	Y	–	4	64 K	$ 95	–	File	Menu	Cromemco BASIC
Micro Manager	9	–	Y	Y	Comb	48 K	$249	–	File	Menu	–
Data Manager	10	Y	–	–	4	32 K	$ 49	–	File	Menu	–
Dynamic DB	10	Y	–	–	1	32 K	$ 25	–	File	Menu	–
IDM-IV	10	Y	–	–	4	32 K	$ 69	–	File	Menu	Radio Shack BASIC; sorts in machine language
IDM-M2	10	–	Y	–	4	64 K	$199	–	File	Menu	Radio Shack BASIC; sorts in machine language
Profile	10	Y	–	–	4	16 K	$ 80	–	File	Menu	Machine language
Profile II	10	–	Y	–	4	32 K	$179	Scripsit/$300	File	Menu	Machine language

"Comb" in column 5 means support for 5-inch, 8-inch, or hard disks in combination.

1 Any with machine's DOS*
2 Any with CP/M*
3 Z80
4 Apple, PET, TRS-80
5 Apple, TRS-80
6 Apple
7 Commodore PET
8 Cromemco
9 Ohio Scientific
10 TRS-80

*Where any means any one of the following:

Cromemco
Apple
TRS-80
8080
8085
Z80
6502
8086
North Star
Zilog

Table 1: *Some general features of the twenty data-base management systems participating in the survey.*

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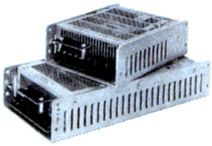

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SF, 100W : $170.00
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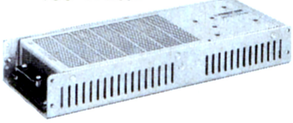

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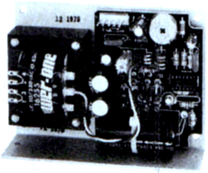
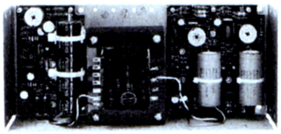


CP340, 1 Drive : $44.95
CP323, Up to 4 Drivers : $74.95

8.0″ FLOPPY SUPPLIES



CP205, 1 Drive : $69.95
CP206, 2 Drives : $91.95
CP162, Up to 4 Drives : $120.00

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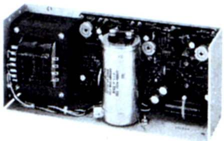
2 Models to Power any Manufacturer's Drive



CP379, CP384 : $120.00

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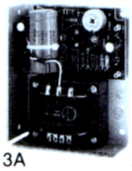

5V @ 3A
12V @ 1.7A
15V @ 1.5A
24V @ 1.2A
28V @ 1.0A
250V @ 0.1A

HB Series : $24.95

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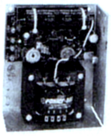

5V @ 6A
12V @ 3.4A
15V @ 3.0A
24V @ 2.4A
28V @ 2.0A
48V @ 1.0A

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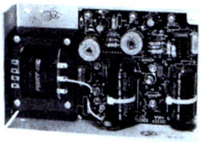

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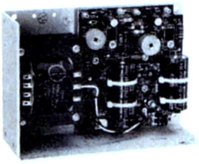

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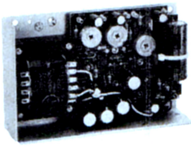

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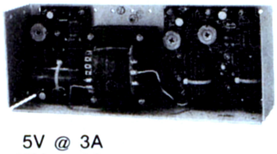

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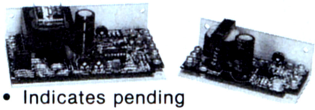

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Power One Drive • Camarillo, CA 93010 • (805) 484-2806 • (805) 987-3891 • TWX 910-336-1297 permits a user to look at information as tables, regardless of how it is actually stored on the disk. For the suppliers and parts information, a relational DBMS could produce tables that look like the files of a multifile system. But in a relational system, these tables might be stored on disk in ways other than one file for each table. Condor, for example, keeps several files for each table. Condor is a limited relational system, but the company plans to release a version that can perform all the commands necessary to qualify as a fully relational system. The names of Condor's commands suit a business environment; for example, the command "POST" will update one table with another.

Systems of the type "network," on the other hand, let the user view the data as a network of files. The suppliers and parts information could be envisioned as shown in figure 1.

The network system allows the user to navigate through the records contained in the Suppliers file or Parts file with commands such as FIND NEXT RECORD or FIND PREVIOUS RECORD. In addition, a user positioned at a record in the Parts file where the part number is 124 could find the addresses of suppliers of that part by linking through the Supplier-Parts file to the Suppliers file. MDBS qualifies as a full network system. Its extension package, QRS, enables a user with no knowledge of the network navigational paths to query the data base with English-like commands.

The systems in the first three computer groups, types network, relational, and multifile, are the only systems that can access more than one data file at a time. This is important for tasks of the following types:

- Posting from one file to another.
- Printing a report that is made up of fields from more than one file.
- Creating one large list from several smaller ones.
- Producing a list that consists of records that meet certain criteria when those criteria are based on requirements from more than one file. For example, producing a list of the names and telephone numbers of suppliers from whom you can purchase a specific part.

According to the "Command Entry Method" column of table 1, some of the systems give the user a menu from which to choose a command, others require the user to type out commands, and a few systems let the user enter commands either way.

Features Related to Ease of Use

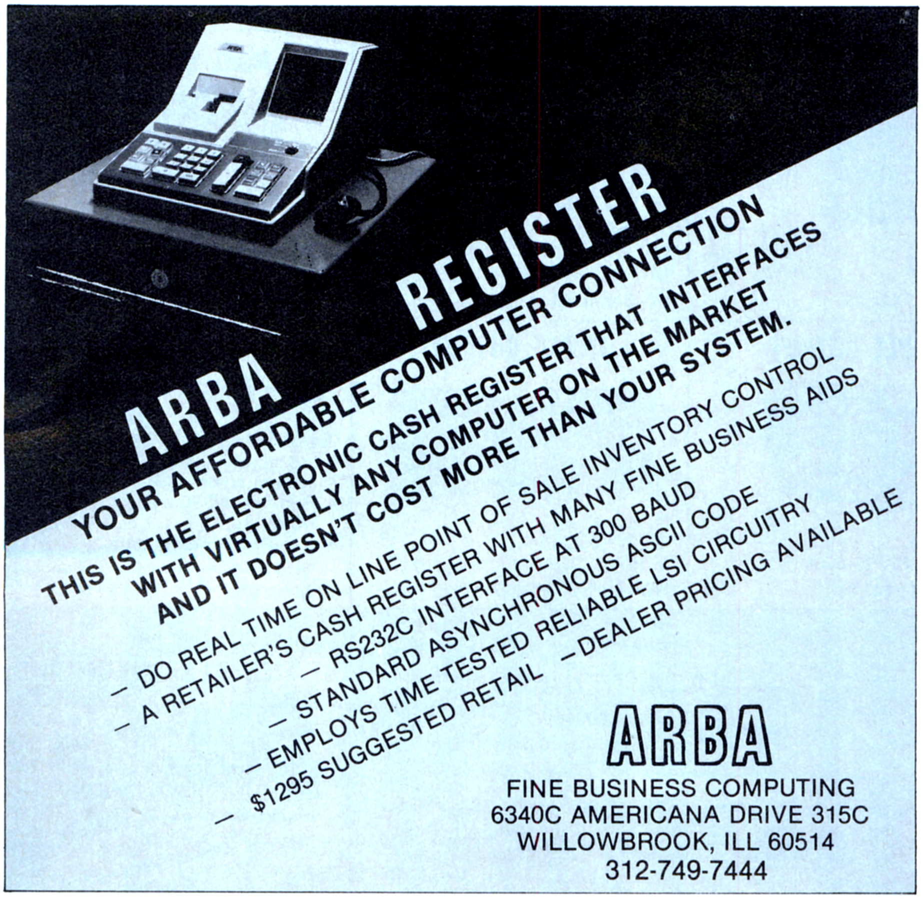
Software packages capable of performing amazing feats are worthless if using the software is more difficult than solving the original problem. Table 2 provides information about features that make DBMSs easier to use.

When reading the table, however, keep in mind that a few of the features are unnecessary on some of the DBMSs. One such feature is the ability to customize the DBMS for a specific terminal (column 1). If a DBMS runs only on a TRS-80 Model I, there is no need to customize the software for other terminals. In effect, the DBMS is already customized.

Most features in table 2, however, would benefit users of any system. An example is column 3, "Error Recovery." Error-trapping can prevent a system from crashing when the user tries to enter data of the wrong type. The cause of most crashes is an error the system failed to trap. The user manuals of six systems warn that certain errors in data entry will cause a system crash; six other manuals (question marks in the table) leave the issue in doubt.

But there are also six DBMSs that do provide error-trapping. Some systems provide error-recovery functions to deal with hardware failures, such as loss of power. Some systems allow the user to recapture data entered earlier. MDBS offers extensive error-trapping facilities. The manual devotes 75 pages to explaining the system's error messages.

Should the user of a particular system be a programmer? A "Y" in col-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umn 13 of table 2 shows that the system belongs to one of the following three categories:

- Designed to be used by a programmer. Some systems assume the programmer will modify the system to suit the user's needs. Some of the smallest, least expensive systems (such as Data Handler) are of this type. Dynamic Data Base, for example, instructs the user to modify the system in order to sort.
- Does not require any knowledge of a programming language but is too difficult for a novice to understand. Microconductor and IDM-M2 fall in this category. Their user manuals contain computer jargon that would baffle anyone but a programmer.
- Designed in such a way that only a programmer can benefit from everything the system offers. FMS-80's user manual, for example, has explanations for three different levels: novice, experienced FMS-80 user, and programmer.

A "Y" in column 4, "Programming Language Interface," indicates that

	Can Customize System to Terminal	Can Customize System to Printer	Error Recovery	Programming Language Interface	Storage Transparent to User	User-Designed Screens for Data Entry	Help Command	Levels of Data Security	Sort Maintained	Ascending and Descending Order	Derived Data	Alternate Views	User Should Be Programmer	Batch Commands Available
MDBS	Y	Y	Y	Y	Y	N	N	512	Y	Y	Y	Y	Y	Y
FMS-80	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
Selector IV	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	N	Y	Y
TIM	Y	Y	Y	Y	N	N	Y	1	Y	Y	Y	N	Y	N
Condor	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y
Data Handler	N	N	N	N	N	N	N	N	N	Y	N	N	Y	N
CCA	N	N	Crashes	Y	N	N	N	N	Y	Y	Y	N	Y	N
Microconductor	N	N	?	N	Y	N	Y	N	N	Y	Y	Y	Y	Y
Information Mstr	N	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	N	N
The Informer	N	N	?	N	N	Y	N	N	N	N	N	N	N	N
Micro Info Sys	N	N	?	N	Y	N	N	N	N	Y	Y	N	Y	N
Jinsam 2.0	N	Y	Y	Pkg Avail	Y	N	Y	3	Y	Y	Y	N	N	N
Cromemco	N	N	Crashes	N	Y	N	N	N	Y	N	N	N	N	N
Micro Manager	N	N	?	N	Y	N	N	1	N	Y	N	N	Y	N
Data Manager	N	Y	Crashes	N	N	N	N	1	N	N	N	N	N	N
Dynamic DB	N	N	Crashes	N	Y	N	N	N	N	N	Y	N	Y	N
IDM-IV	N	N	Crashes	N	N	Y	N	N	Y	N	N	N	Y	N
IDM-M2	N	N	Crashes	N	N	Y	N	2	Y	N	Y	N	Y	N
Profile	N	N	?	Y	N	Y	N	1	N	Y	Y	N	N	N
Profile II	N	Y	?	N	Y	Y	N	4	Y	N	Y	Y	N	N

Table 2: *Features of data-base management systems that affect ease of use. In the "Error Recovery" column, "CRASHES" indicates that the user manual said certain errors in data entry would cause the system to "hang" or "crash."*

the system allows a programming language to access the data-base files either directly or through the DBMS. For example, Profile's user manual contains several lines of code to be embedded in a BASIC program, while Jinsam offers an interface package on disk. MDBS can also be embedded in a host language such as BASIC, Pascal, or FORTRAN. This allows a program to access the DBMS with subroutine calls.

By definition, a DBMS hides its method of physical storage from the user. The storage method is said to be "transparent to the user." Some of the manuals, however, have explained how their files are set up. These systems are indicated in column 5.

A user-designed screen (column 6) makes a system both more versatile and more pleasant to use. Normally, the fields of a record are placed one below the other on the screen. But a file may contain too many fields to fit on the screen at one time, preventing the user from simultaneously viewing them all. A screen designed by the user can position fields at any location desired. Several screens can be designed for viewing a record with many fields. Profile II allows characters or lines to divide or highlight portions of the screen, and also supports reversed lettering.

A help command, shown in column 7 of table 2, is often provided by systems that require the user to enter commands, rather than choose from the choices on a menu. In response to the help command, the system produces a list of commands the user might need. Condor allows users to design the help responses. The responses can then include the names of the tables or files the user has specified.

Data security (column 8) is important if more than one person will be using the system, and if only certain persons are allowed to see some parts of the data. Security provisions range from one level of protection, which permits a data disk to be read only

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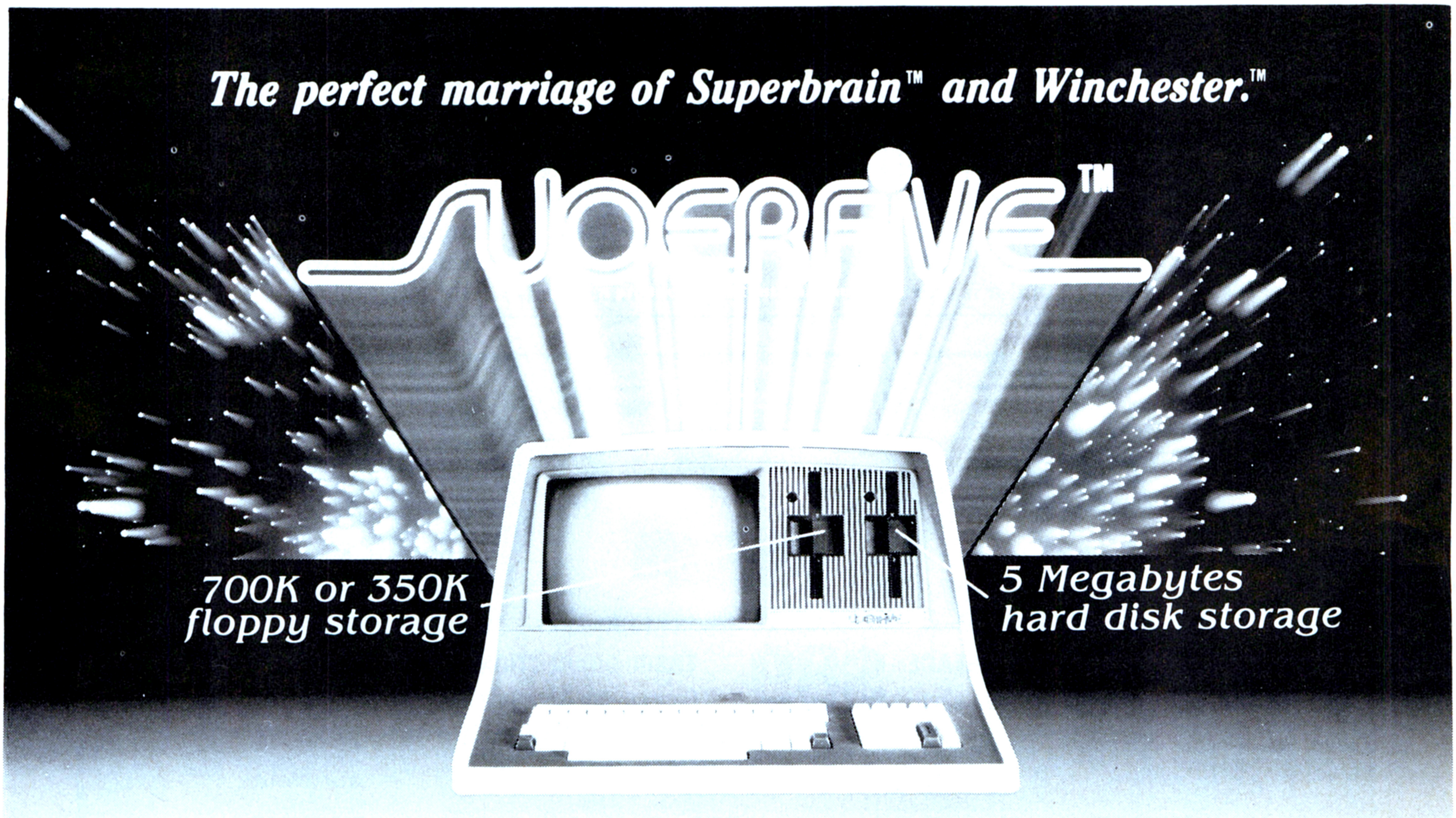

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with the proper password, to the 512 possible levels of protection offered by MDBS.

Some systems allow alternate views of the same data. For example, a user-designed screen can suppress specific fields from view. This is useful if a clerk's job is to update personnel files, but the employer does not want the clerk to see sensitive figures such as the salaries of other employees.

MDBS assigns each user a password and also a read-access level and write-access level from 0 to 255. A record with a read-access level of 0 can be read by everyone. A read-access level of 5 prevents viewing by all but those with an access level of 5 or above.

To ensure data integrity, a system must offer protection against accidental or malicious data entry. Profile II provides protected fields in which data, even though it can be seen, cannot be changed. Profile II also offers a limited menu that allows the user to query, print, or update, but prevents creation of files or formats. Condor is the only system that can accept a range of values for the purpose of validating data entry.

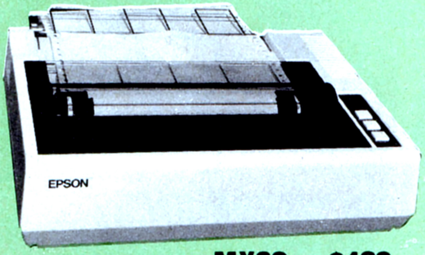
All twenty systems provide a routine to sort or order the data, but column 9 of table 2 shows that only half the systems *maintain* the data in sorted order. A maintained sort assures that further entries will be inserted in their proper order.

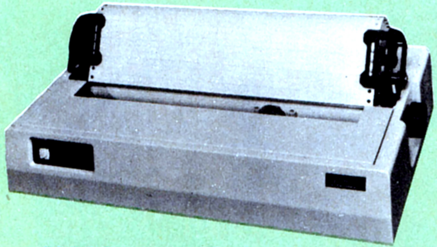
Derived data (column 11) are data produced by operations on other data. Examples of derived data are the sum of a column, the number of records counted, etc. (Table 8c, discussed later, shows the specific derived-data functions each system provides.)

The term "batch" in the last column of table 2 may be unfamiliar to some readers, but the concept is easy to understand. Batch commands are usually offered by systems that require the use of commands rather than providing a menu of choices. Simply stated, a user can write several instructions on the screen and then have them all carried out at once—in a batch. For example, the user can write commands on the screen telling the system to read a particular file, select all records in that file in which the state is Florida, list on the printer the names and addresses found in those records, place that same list in a new file, and name the new file FLORIDA. After entering this sequence of commands, the user can take a coffee break while the computer executes the entire sequence.

Defining Data

Table 3 presents information on available methods for defining the data a file is to contain. Most of the systems, as shown in column 2, allow the user to specify the data type of a specific field. Examples of data types are numeric, date, and character. The table abbreviates data types and lists the spelled-out names at the bottom. The calculated-field type means data in the field will be automatically calculated, as specified by the user, from the contents of other fields whenever data are entered or modified in those fields. Only two systems, CCA and TIM, offer this feature. Only one sys-





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tem, FMS-80, allows data fields to vary in length.

Many of the systems require that a field be defined as a key field, and several systems allow more than one field to be used as a key field. Other systems allow sorting or searching of any field. Data Handler allows no field definition; an entire record is entered as a stream of characters. Then, to access any particular part of the record as a field, the user must give the beginning column number and a length.

	Field Name	Field Types Defined	1 Key Field	Multi Key Fields	Maximum # Fields Allowed	Revision Allowed
MDBS	Y	Int Char Bin Real Log	Y	Y	255	Y
FMS-80	Y	A N V	Y	Y	255	Y
Selector IV	Y	A N J G K U	Y	Y	80	Y
TIM	Y	N C D $ I S	N	N	24	Y
Condor	Y	A N $ J An	N	N	127	N
Data Handler	N	–	N	N	0	N
CCA	Y	A N C	Y	Y	24	Y
Microconductor	Y	A $ % ! #	N	N	20	N
Information Mstr	Y	A N $	N	N	20	N
The Informer	Y	–	Y	Y	?	N
Micro Info Sys	Y	–	Y	N	22	?
Jinsam 2.0	Y	–	Y	Y	255	Y
Cromemco	Y	A N	N	N	25	?
Micro Manager	Y	–	Y	N	75	N
Data Manager	Y	A N	Y	Y	10	?
Dynamic DB	Y	A N	N	N	?	N
IDM-IV	Y	A N	Y	Y	20	N
IDM-M2	Y	A N	Y	N	40	N
Profile	Y	–	N	N	–	N
Profile II	Y	A N Dec	Y	Y	–	N

A	Alpha	G	Date
N	Number	U or K	Key
C	Calculated	I	Inverted
J or D	Date	An	Alphanumeric
$	Dollar	% ! #	Basic lang extension
V	Variable	Dec	Decimal

Table 3: *Facilities for defining data fields. Systems vary widely in their provisions for defining key fields (to be used for sorting) and in the number of fields allowed. Only six systems permit revising the characteristics of a field without losing previously entered data.*

Most of the systems specify a maximum number of fields allowed. This number differs significantly from MDBS's 255 to Data Manager's 10. Though the maximum allowed by IDM-IV is 20, there is also a maximum of 10 alphabetic fields and 10 numeric fields. IDM-IV would not allow, for example, 15 numeric fields. Microconductor limits its fields to 20, but then allows 20 subfields for each of the 20 fields. Many systems restrict the number of fields by the number of characters allowed per record, so the maximum number of fields in any specific file depends on the field length chosen. At the other extreme, Micro Information System always uses 22 fields.

Not surprisingly, the number of records or files allowed depends on the number of disk drives used, the size of the disks, etc.

"Definition Revision," the last column of table 3, refers to revision of field definitions such as length and type. A "Y" in this column indicates that revision is possible after data have been entered and will not cause loss of the previously entered data.

More Than One File at a Time

Systems that can access more than one file at a time usually provide the features included in table 4. With the subfile feature, the user can create a new file from an old one. An example is dividing a long mailing list into shorter lists by state. The user can also combine files or create a new file consisting of selected records from more than one old file. For example, a user might select from two files the names and addresses of widget manufacturers and place the names and addresses in a new file.

Updating Data

Table 5 shows the variations found in facilities for updating data. Some systems bar entry of some specific

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characters as data; those characters are listed in column 1.

All systems let the user update one record at a time, but column 2 shows that only seven systems provide a method for simultaneously updating all records that meet specified criteria. Adding $5 to all records with a balance less than zero is a task that would require this multirecord capability. Data Handler has a process called "Mass Update." First, a column and length are specified as a field. Then, for each sequential record in turn, the user can enter a replacement value for that field. This is not an automatic multirecord update, however, because the user must change each record one at a time.

To speed data update and entry, TIM, Jinsam, Selector IV, Information Master, and FMS-80 permit one-key copying of data from a previous record's field.

Criteria for Selecting Records

A selection criterion is a rule against which a record can be tested to see if it qualifies for selection. The selection criterion can be simple and straightforward, such as "Part# > 124." On the other hand, the selection criterion can be complex: "Part# > 124 AND Part# <> 130 OR Part-name = widget." Relational systems usually permit the user to specify that the value in a field of one file match the value in a field of another file. Multifile systems pro-

	Subfile	Combination of Files
MDBS	Y	Y
FMS-80	Y	Y
Selector IV	Y	Y
TIM	Y	N
Condor	Y	Y
Data Handler	N	Y
CCA	N	N
Microconductor	N	N
Information Mstr	N	N
The Informer	N	N
Micro Info Sys	N	N
Jinsam 2.0	N	N
Cromemco	N	N
Micro Manager	N	N
Data Manager	N	N
Dynamic DB	N	N
IDM-IV	N	N
IDM-M2	N	N
Profile	N	N
Profile II	N	N

Table 4: *Facilities for accessing more than one file at a time. Only five systems can make a new file from part of an old file, and only five can combine old files or parts of old files to make a new file.*

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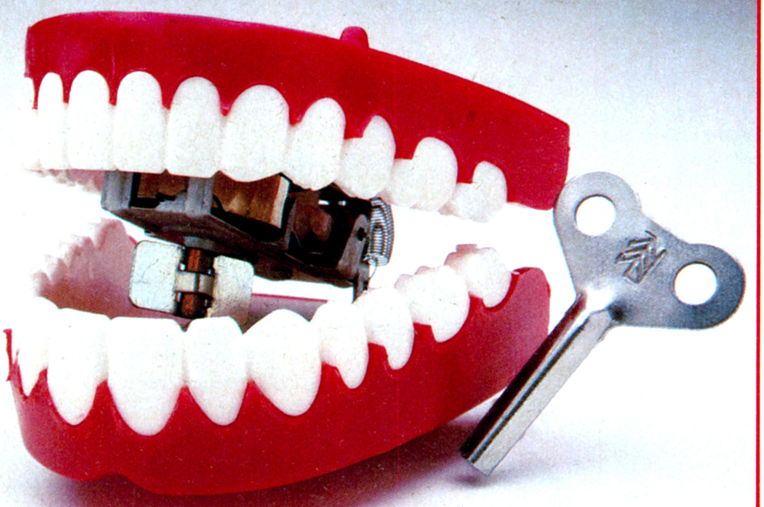

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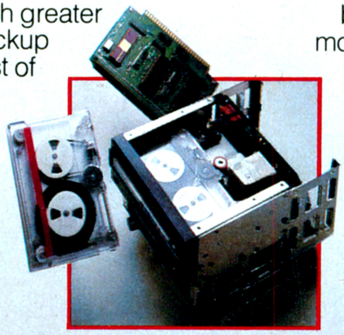

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```
84 | PROCEDURE wand_input;
85 |    BEGIN {wand_inp
86 |       read_cod
87 |    IF
88 |
89 |
90 |
```

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vide the latter capability with the use of batch commands.

Table 6 shows that all systems but one use selection criteria to specify conditions on at least one field. All but four systems allow a user to request that more than one field meet given criteria. Most of the systems permit a user to search for a record falling within a specified range. Most systems also allow the user to enter only a substring of the desired field value. For example, "Smi" would return "Smith " as well as "Smiley." But only six systems allow you to ask if a field contains nothing at all. This

	Characters Not Allowed in Field Data System Limitation	Updates One Record at a Time	Automatically Updates Multirecords at One Time	System Triggered Updates	Predefined Updates	Update Produces Audit Trail	Selection Criteria Used for Global Updates
MDBS		Y	Y	N	Y	Y	Y
FMS-80		Y	Y	Y	Y	Y	Y
Selector IV		Y	Y	N	Y	N	Y
TIM	,	Y	N	Y	N	N	N
Condor		Y	Y	N	Y	Y	Y
Data Handler	, ;	Y	N	N	N	N	N
CCA	,	Y	N	Y	N	N	N
Microconductor		Y	N	Y	Y	N	N
Information Mstr		Y	Y	N	N	N	Y
The Informer	, : " "	Y	N	N	N	N	N
Micro Info Sys	,	Y	Y	N	N	N	Y
Jinsam 2.0	, : " " * shift	Y	N	N	N	N	N
Cromemco		Y	N	N	N	N	N
Micro Manager		Y	Y	N	N	N	N
Data Manager		Y	N	N	N	N	Y
Dynamic DB		Y	N	N	N	N	N
IDM-IV		Y	N	N	N	Y	N
IDM-M2		Y	N	N	N	Y	N
Profile		Y	N	N	N	N	N
Profile II		Y	N	N	N	N	N

Table 5: *Facilities for updating data. Seven systems provide a method for simultaneously updating all records that meet specified criteria (column 3).*

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facility could be used to determine which records have not been updated, to find errors, or to print only records that contain data in a particular field.

Predefined Queries

Some systems let you define a query, name it, and use it repeatedly by calling its name; table 7 shows which systems provide this facility. A

	Conditions on 1 Field	Conditions on 1 + Fields	Complex Nested Conditions	Maximum # Conditions Allowed	Multifile/Set Conditions	Range	Substring	Null Value
MDBS	Y	Y	Y	No limit	Y	Y	Y	N
FMS-80	Y	Y	Y	No limit	Y	Y	Y	Y
Selector IV	Y	Y	Y	10	Y	Y	Y	Y
TIM	Y	Y	Y	?	N	Y	Y	Y
Condor	Y	Y	N	32	Y	Y	Y	?
Data Handler	N	N	N	–	N	N	N	N
CCA	Y	Y	Y	–	N	Y	Y	N
Microconductor	Y	Y	N	–	N	N	Y	N
Information Mstr	Y	Y	Y	6	N	Y	Y	Y
The Informer	Y	Y	N	–	N	?	Y	N
Micro Info Sys	Y	Y	N	–	N	N	Y	Y
Jinsam 2.0	Y	Y	Y	# of fields	N	Y	Y	N
Cromemco	Y	Y	N	–	N	Y	N	N
Micro Manager	Y	N	N	–	N	N	Y	N
Data Manager	Y	N	N	–	N	Y	N	N
Dynamic DB	Y	Y	N	–	N	N	Y	N
IDM-IV	Y	Y	N	–	N	Y	N	N
IDM-M2	Y	Y	Y	4	N	Y	Y	N
Profile	Y	N	N	–	N	N	Y	N
Profile II	Y	Y	N	–	N	Y	Y	N

Table 6: *The kinds of criteria by which data-base management systems can select records. Most systems allow the user to search for a record that falls within a certain numerical or alphabetical range. Only four systems allow you to select from multiple files all the records that meet a set of conditions ("Multifile/Set Conditions").*

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query is usually, though not necessarily, displayed on the terminal screen, while a report is usually printed on paper with titles, etc. A predefined query thus permits periodic viewing of a list of records meeting a specific requirement, such as past due accounts, by entering all the information only the first time the query is used. A few systems limit the number of predefined queries a user can keep.

Column 3 of table 7 shows which systems allow a predefined query for which the user can enter a value at the time the query is used. That value might be the date that identifies an account as past due. Such a query could be used through the year, but with a different date each month.

Producing Reports

Reporting capabilities vary widely from system to system. In order to

	Possible	Maximum # Allowed	Modifiable When Used
MDBS	Y	–	N
FMS-80	Y	–	Y
Selector IV	Y	–	Y
TIM	Y	–	Y
Condor	Y	–	Y
Data Handler	N	–	N
CCA	N	–	N
Microconductor	N	–	N
Information Mstr	Y	15	N
The Informer	Y	–	N
Micro Info Sys	N	–	N
Jinsam 2.0	Y	–	N
Cromemco	N	–	N
Micro Manager	N	–	N
Data Manager	N	–	N
Dynamic DB	N	–	N
IDM-IV	N	–	N
IDM-M2	N	–	N
Profile	N	–	N
Profile II	Y	5	N

Table 7: *Facilities for predefined queries. It is a real convenience to be able to define and name a query, and then repeat the query without reentering its parameters.*

	Can Be Written to File	Format Predefined	Maximum # Predefined Formats	Uses Multiple Data Files
MDBS	Y	Y	?	Y
FMS-80	Y	Y	255	Y
Selector IV	N	Y	?	Y
TIM	N	Y	?	N
Condor	Y	Y	?	Y
Data Handler	Y	N	0	N
CCA	N	Y	20	N
Microconductor	Y	Y	?	N
Information Mstr	N	Y	15	N
The Informer	Y	Y	?	N
Micro Info Sys	N	Y	3	N
Jinsam 2.0	N	Y	Unlimited	N
Cromemco	N	N	0	N
Micro Manager	N	N	0	N
Data Manager	N	Y	?	N
Dynamic DB	Y	N	0	N
IDM-IV	Y	Y	10	N
IDM-M2	N	Y	10	N
Profile	N	Y	1	N
Profile II	N	Y	5	N

Table 8a: *General facilities for generating reports. Few systems can generate reports from multiple files. The ability to use predefined formats to generate reports from multiple files permits rapid production of complex reports.*

Chief Relief

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discuss the features listed in tables 8a through 8c, consider a hypothetical system having all those features. Such a system would allow a user to define a report format. The user could give the report a title, column headings, insert a paragraph of text, specify that some fields should print in ascending order, and that, within that ordering, other fields should print in descending order.

The user could set the column widths, justify the margins, print a sample record to help line up the form on a printer, specify the number of lines to skip between each record, specify a break when a certain field changes value, and then print subtotals or perform any of several statistical or mathematical functions.

	Title	Heading	Footing	Column Widths	Text Inserts	Margin Justification	Margin	Sample	# Lines Skipped Between Records	# Characters Between Records	# Records Across Page	# Lines/Record	Summary Breakpoints
MDBS	Y	Y	N	Y	N	N	Y	N	N	Y	N	N	Y
FMS-80	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Selector IV	Y	Y	?	?	?	?	?	?	?	?	?	Y	Y
TIM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Condor	Y	Y	N	Y	N	N	Y	N	N	N	N	Y	Y
Data Handler	N	N	N	N	N	N	N	N	N	N	N	N	N
CCA	Y	N	N	Y	N	Y	N	Y	N	N	Y	Y	Y
Microconductor	Y	Y	N	N	N	N	N	Y	N	N	N	N	Y
Information Mstr	Y	Y	N	Y	Y	N	Y	N	Y	N	N	Y	Y
The Informer	Y	Y	N	N	N	N	N	N	Y	Y	N	N	N
Micro Info Sys	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N
Jinsam 2.0	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	N	N
Cromemco	N	N	N	N	N	N	N	N	N	N	N	Y	N
Micro Manager	Y	Y	N	Y	N	N	Y	N	Y	Y	N	Y	N
Data Manager	N	Y	N	N	N	N	Y	N	N	N	N	N	N
Dynamic DB	N	N	N	N	N	N	N	N	N	N	N	N	N
IDM-IV	Y	N	N	N	N	N	N	N	N	N	N	N	N
IDM-M2	Y	N	N	N	N	N	N	N	N	N	N	N	N
Profile	Y	Y	N	Y	N	Y	N	Y	N	N	N	N	N
Profile II	Y	Y	N	N	N	N	Y	N	N	N	Y	Y	Y

Table 8b: *Facilities for formatting reports.*

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NORTHERN CALIFORNIA
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Terminal Rentals
San Jose, CA (408) 292-9915
Byte Industries
Hayward, CA (415) 783-8272
Computerland
San Leandro, CA (415) 895-9363

SOUTHERN CALIFORNIA
Basic Electronic Distributors
Inglewood, CA (213) 673-4300;
San Diego, CA (714) 268-8000
Terminal Rentals
Tustin, CA (714) 832-2414

SOUTHWEST
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Richardson, TX (214) 231-2573;
Houston, TX (713) 688-9971; Austin, TX (512) 451-0217

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Scottsdale, AZ (602) 947-7841;
Albuquerque, NM (505) 299-7658;
Murray, UT (801) 262-3000

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Tek-Aids, Inc.
Arlington Heights, IL (312) 870-7400
Comtel Corporation
Chicago, IL (312) 539-4838; St. Louis, MO (314) 428-5508;
Shawnee Mission, KS (913) 722-1030; Minneapolis, MN (612) 835-3060; Indianapolis, IN (317) 253-1681;
Cedar Rapids, IA (319) 377-9434;
Brookfield, WI (414) 786-1940

NORTHEAST (Connecticut, Vermont, Massachusetts, Maine, Rhode Island, New Hampshire)
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Woburn, MA (617) 938-0488
Microamerica Distributors
Needham, MA (617) 449-4310

NEW YORK METROPOLITAN AREA
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Fort Lee, NJ (201) 224-6911 / (212) 594-8202

MID-ATLANTIC STATES (Maryland, Washington, DC, Virginia, W. Virginia, E. Pennsylvania, S. New Jersey)
Micro Distributors, Inc.
Rockville, MD (301) 468-6450
Plymouth Meeting, PA (215) 265-1600

SOUTHEAST STATES (Louisiana, Florida, Alabama, Mississippi, Georgia, N. Carolina, S. Carolina)
Currie, Peak & Frazier, Inc.
Huntsville, AL (205) 536-1506;
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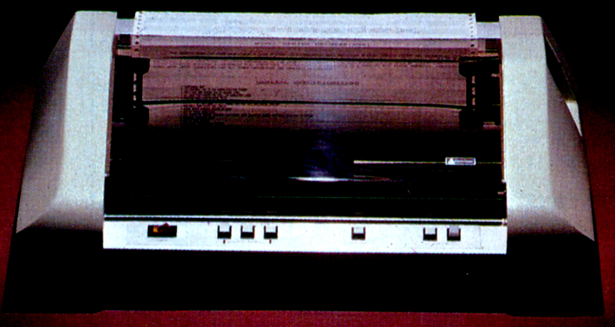

Since their introduction in mid-1980, the Anadex high-resolution DP-9500 Series matrix printers have set new standards for printer quality and performance. All models feature the rugged Anadex 9-wire print head that combines long life with resolutions of 72 dots/inch vertical and up to 75 dots/inch horizontal. With this kind of resolution, fineline graphics (under data source control) and razor sharp characters are pluses built into every printer.

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Standard in all models are the three ASCII compatible interfaces (Parallel, RS-232-C, and Current Loop). Also standard is a sophisticated communications interface to control Vertical Spacing, Form Length and Width, Skip-Over Perforation, Auto Line Feed, X-On/Off, and full point-to-point communications.

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A user could even print a column for which there is no data stored. For example, the system might allow, for each record, that the second column be multiplied by the third and the result put in a new fourth column. The system might then print grand totals in yet another column.

The user could specify record numbering, choose to have footings printed on each page, and use information from several files. A user could save all these specifications in a predefined report format and use the format every month without reentering the specifications.

Tables 8a through 8c show that several systems offer many of these features, but some systems offer only a few.

	Sums	Means	Minimums	Maximums	Roots	Weights	Count	Statistics	Average	User Defined	Column Resulting from Operation on 2 Columns	Record Numbering
MDBS	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N
FMS-80	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y
Selector IV	Y	N	N	N	N	N	N	N	N	Y	Y	?
TIM	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	?
Condor	Y	N	Y	Y	N	N	N	N	Y	N	Y	N
Data Handler	N	N	N	N	N	N	N	N	N	N	N	N
CCA	Y	N	N	N	N	N	N	N	N	N	N	Y
Microconductor	Y	N	Y	Y	N	N	N	N	N	N	N	N
Information Mstr	Y	N	N	N	Y	N	N	N	N	Y	Y	Y
The Informer	N	N	N	N	N	N	N	N	N	N	N	N
Micro Info Sys	D	N	N	N	N	D	D	N	D	N	N	Y
Jinsam 2.0	(2)	(2)	(2)	(2)	(2)	(2)	Y	(2)	(2)	N	(2)	Y
Cromemco	N	N	N	N	N	N	N	N	N	N	N	N
Micro Manager	N	N	N	N	N	N	N	N	N	N	N	N
Data Manager	N	N	N	N	N	N	N	N	N	N	N	N
Dynamic DB (1)	D	D	N	N	N	N	N	N	D	N	Y	N
IDM-IV	Y	Y	N	N	N	N	Y	N	Y	Y	N	Y
IDM-M2	Y	N	N	N	N	N	Y	N	Y	Y	Y	Y
Profile	N	N	N	N	N	N	N	N	N	N	N	N
Profile II	Y	N	N	N	N	N	N	N	N	N	N	Y

(1) Not printed; displays on screen for 15 seconds
(2) Stat and Mathpack Available
D Display only (*not* printed)

Table 8c: *Facilities for deriving new data from existing records to create a report. Only MDBS and TIM can derive statistics, although Jinsam offers an extension package for statistics.*

Some of the less expensive systems have excellent report generators. Note in the tables all the features Information Master offers. More expensive systems provide multifile report capabilities. Selector IV, for example, can report on up to 80 fields from as many as six files. TIM has its own built-in text editor that allows you to prepare form letters, checks, invoices, and the like. Profile II and Jinsam encourage the use of their word-processing packages in conjunction with their DBMSs. This combination enables the user to personalize form letters.

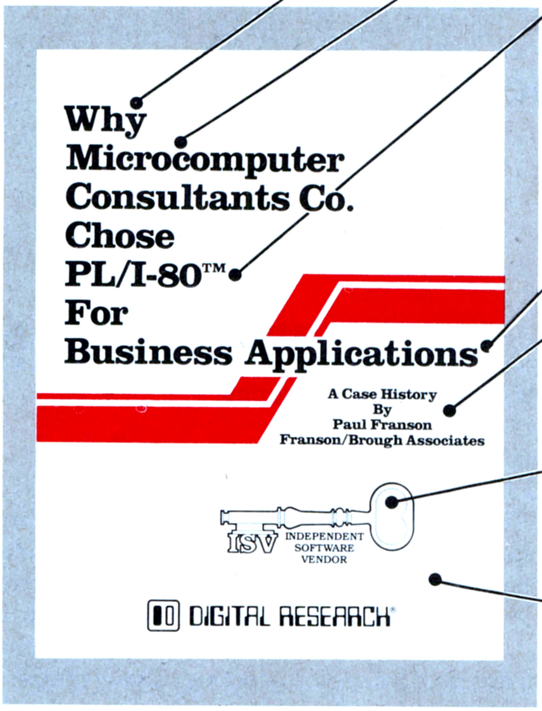
Conclusion

We caution the reader against basing a buying decision solely upon the information in this article. Though we have attempted to show where these DBMSs differ and what functions they perform, a report as compact as this can present only a limited amount of information.

Of course, these twenty systems do not include all software packages advertised as DBMSs. Several new packages are currently being marketed, as are upgraded versions of some of these twenty. We believe that a potential buyer, by studying these tables, can determine which features he or she considers most important and then seek a system that offers those features.

Attempts are being made to provide integrity, security, and data independence in data-base management systems for microcomputers. Even the smaller systems have provided a feature here and there that works toward these three goals. MDBS appears to have come close to achieving all three. For software as young as data-base management systems, and hardware as young as microcomputers, the achievement of Micro Data Base Systems, Inc, is impressive. ■

PL/I-80™: Not for beginners*



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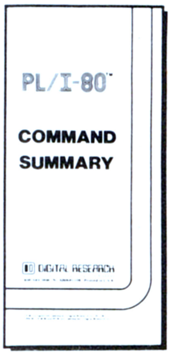

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PDQ: A Data Manager for Beginners

Don't Reinvent the Wheel

Paul Swanson
97 Jackson St
Cambridge MA 02140

Floppy-disk drives are fantastic devices to add to a computer. They hold more information and are faster and more reliable than cassette tapes or other data-management systems. For the sophisticated personal user, they are essential, but managing the amount of data they hold presents a problem—especially if you are trying to do the programming yourself. This article presents the PDQ Key-File System, a data-management method that offers a good compromise between speed of data retrieval and ease of programming.

Basic Techniques

Fortunately, a large amount of literature is available that will allow you to select some elegantly simple data-management techniques without reinventing the wheel. The easiest way to use a floppy disk is to store data in *sequential files* (see glossary, page 260, for definitions of italicized words) and use the disk as if it were a cassette tape. With a little modification, any program that works with cassettes will work faster by using a disk, but it will not take advantage of the disk's ability to access any portion of the file almost immediately.

Random-access files are the next step toward sophisticated data storage. Using this system, you can divide your data into *records* and read any of the records in any order; it's not necessary to read through half the file to get to one record in the middle. You can modify the file by reading just one record, changing its contents, then rewriting just that one record. You leave the rest of the file alone.

After working with random-access files for awhile, you will notice some annoyances. The one real problem is that records are stored by number. In order to find a record, you must know the right number. There are, however, ways around this: some techniques *sort* the file by arranging the records in order according to the data in each record.

When all the records in the file are sorted, a *searching* technique, usually *binary search*, must still be used to find the desired record. Sorting takes an enormous amount of time, which is another drawback to the random-access method.

Out of frustration, you may "invent" a way to store the name by which you want to find a record in an array in memory, along with the number of the record. Sorting this array in memory is much faster than sorting the entire file, and it gives you an ordered index to the file, but it still takes a long time.

The Key to Managing Data

Reading about data-management techniques may lead you to try other methods, such as *direct hashing* (which is a good method, but allows no way to put the file in alphabetical order—an obvious disadvantage if the data you are managing contains people's names). The end of your search, if you are persistent and selective (see the list of recommended reading on page 262), may be the *key-file* system. This system normally requires an extra disk file (called the key file) to store the names by which you want to refer to the records (the names are called keys). The basic advantage of the key file is that it is smaller than the record file and is, therefore, faster to search through.

There are two drawbacks to using a key file. The first is that it requires two files instead of just one. The first file stores the keys and the other file stores the records. The second drawback is the same as the one involving a random-access file: there still must be some way to find the key in the key file.

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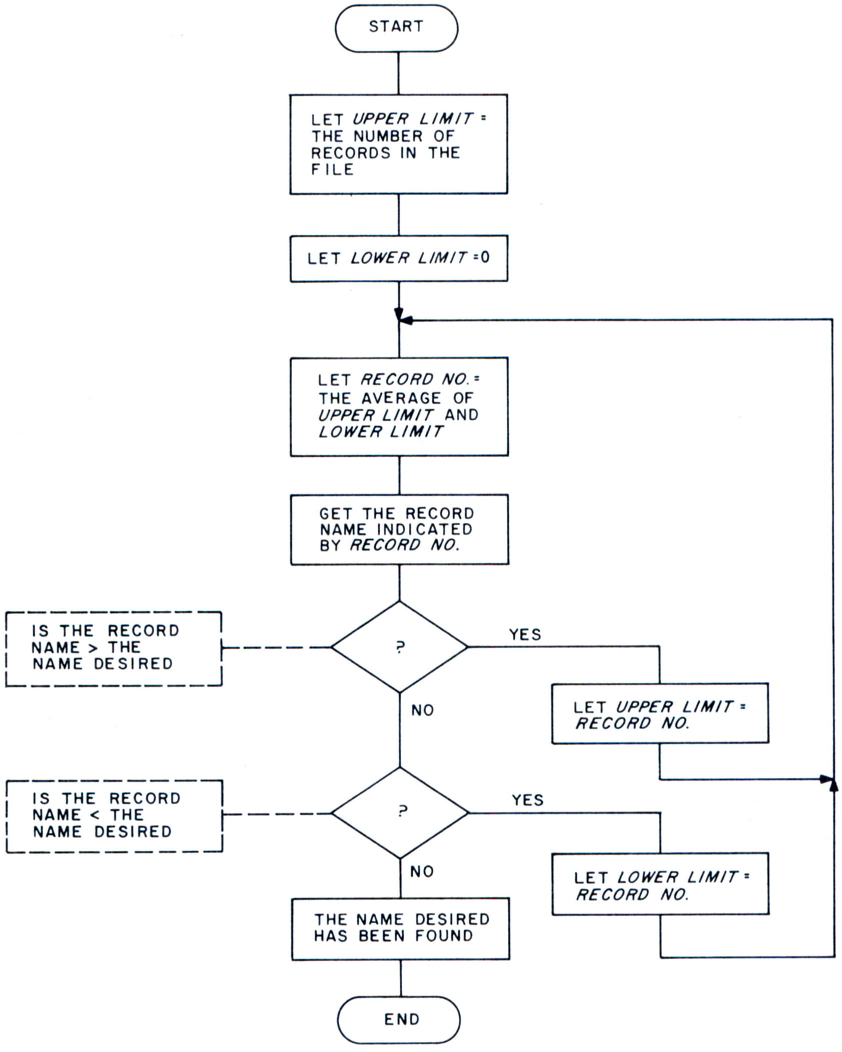
(1a)


START
LET UPPER LIMIT = THE NUMBER OF RECORDS IN THE FILE
LET LOWER LIMIT = 0
LET RECORD NO. = THE AVERAGE OF UPPER LIMIT AND LOWER LIMIT
GET THE RECORD NAME INDICATED BY RECORD NO.
IS THE RECORD NAME > THE NAME DESIRED
?
YES
NO
LET UPPER LIMIT = RECORD NO.
IS THE RECORD NAME < THE NAME DESIRED
?
YES
NO
LET LOWER LIMIT = RECORD NO.
THE NAME DESIRED HAS BEEN FOUND
END

(1b)

RECORD NUMBER	NAME	INVENTORY NUMBER	QUANTITY	SPOIL DATE
10	ZUCCHINI	10553	12000	9/21
9	POMEGRANATES	09631	353	8/17
8	PEACHES	08377	726	8/22
7	OLIVES	40163	68	8/22
6	MANGOES	80192	12	9/03
5	LETTUCE	03926	497	9/12
4	KUMQUATS	67167	521	9/21
3	GRAPES	11131	331	8/27
2	BANANAS	41791	192	9/17
1	ARTICHOKES	10767	226	9/15

Figure 1: *Conducting a binary search through a sorted file. The flowchart for the binary search is given in figure 1a. In order for this searching technique to work, it must operate on a sorted file, as shown in figure 1b. Figure 1b is a sample of the type of information needed for the produce inventory of a market. (Most files will not be this small.)*

Many different methods offer solutions to the second drawback, finding the key. One method sorts the key file. Another technique loads the key file into a large string array in memory, then sorts the string array. But that has the same speed drawbacks as sorting the record file in the first place. *Hashing* methods are also used, and they too have a drawback: there is no way to get the keys back in alphabetical order.

Another method involves saving a few of the keys in the file in alphabetical order, then using one of a variety of methods to load the file into memory in some semblance of alphabetical order.

Key-file systems generally require an enormous amount of programming. I have one, which I use often, that takes four or five pages, depending on the version, to list. For most applications on microcomputers, this much code is not necessary.

The PDQ Key-File System does not require an extra file for the keys. It stores all of the keys, and information required for finding them, on disk, with the records in the record file. It is also shorter to program than other key-file systems. Listing the fundamental routines requires less than two pages. The system is slower than a good separate key-file program, but it is fast enough for applications that require hundreds of records (as opposed to thousands of records).

Basic Binary Search

The PDQ method is loosely based on the same principles used in the binary search. (Binary searching requires a sorted file, but this file will not be sorted.) To understand how the PDQ system works, see the binary search example of a supermarket produce inventory shown in figure 1. Locating a record in a sorted file using the binary search involves dividing ranges of records in half. Using the flowchart of the binary-search algorithm, let's try searching through a file of 10 records for the record named "peaches."

Set the *upper limit* to 11 (10 plus 1). Set the *lower limit* to zero. The variable *record no.* is the average of *upper limit* and *lower limit* (6 for the

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first pass, if you round up). Load this record, "mangoes," into memory. "Mangoes" is not greater than "peaches," it is less; so we set the *lower limit* to 6 and loop back to recalculate *record no.*, but with the limits 6 and 11.

This is how the binary-search method divides the file in half. The number of records to search through has been narrowed down to about five, instead of the 10 we started with. The next loop will look at the record whose number is 9 (the average of the new limits). When this record's name, "pomegranates," is compared with "peaches," the limits will become 6 and 9. This process of dividing the number of records to search continues until "peaches" is found, or until there are no more records to search (ie: *upper limit* is equal to *lower limit* plus one), which means that the record is not in the file.

PDQ Key-File System

As I have mentioned, the PDQ Key-File System uses a modified version of binary searching based on a tree structure (see figure 2). Each record is stored with the key (the name) and two *pointers* that are used in searching: the *greater than* pointer and the *less than* pointer.

Using the same produce-inventory example, the first record in the file is the first one entered, "lettuce." It is simply recorded with each of the two pointers set to zero. When the second record, "olives," is entered, it is necessary to compare its name to that of the first record ("olives" is greater than "lettuce"). The second record is placed in the next available storage space, and the *greater than* pointer in the first record will be set to two. In this way, record one is said to *point to* record two, to indicate that the name of record two is greater than the name of record one. Searching this tree is as simple as following the pointers (see the flowchart in figure 2a).

Unless the keys are entered in a random order, the tree will look lopsided; there is no easy solution to this, but it is not much of a drawback. The system will work most quickly when the tree is perfectly symmetrical. In that form, the system will step through exactly the same keys as it would if it were the sorted file of figure 1b, and the binary search were used. A very lopsided tree will still work, but it will be slower than a symmetrical one. When using the system, don't enter the records in alaphabetical order or the system will search the entire file sequentially. A random order is best.

A Closer Look at the System

The PDQ key-file system (see listing 1) uses an array to define such things as the record length, the key length, etc (see the REM statements on lines 40 through 110 and the DATA statement on line 160, which contains the values for the array in the indicated order). The logic of the key-file system is entirely within the subroutines starting at line 5000. The rest of the listing (lines 200 through 2010) contains a sample application.

The first subroutine gets the number of the next available record in the file. This is done using a counter that occupies record number

Text continued on page 252

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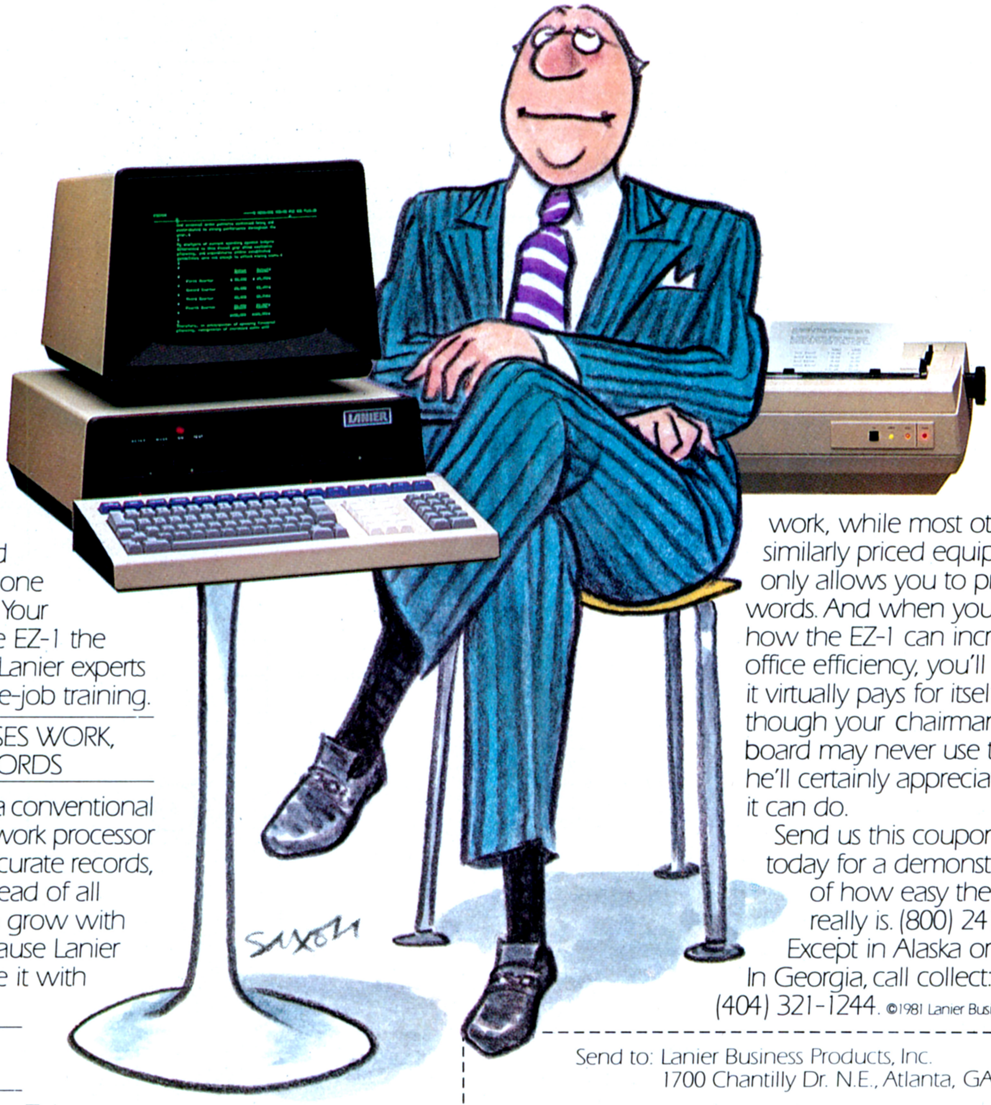

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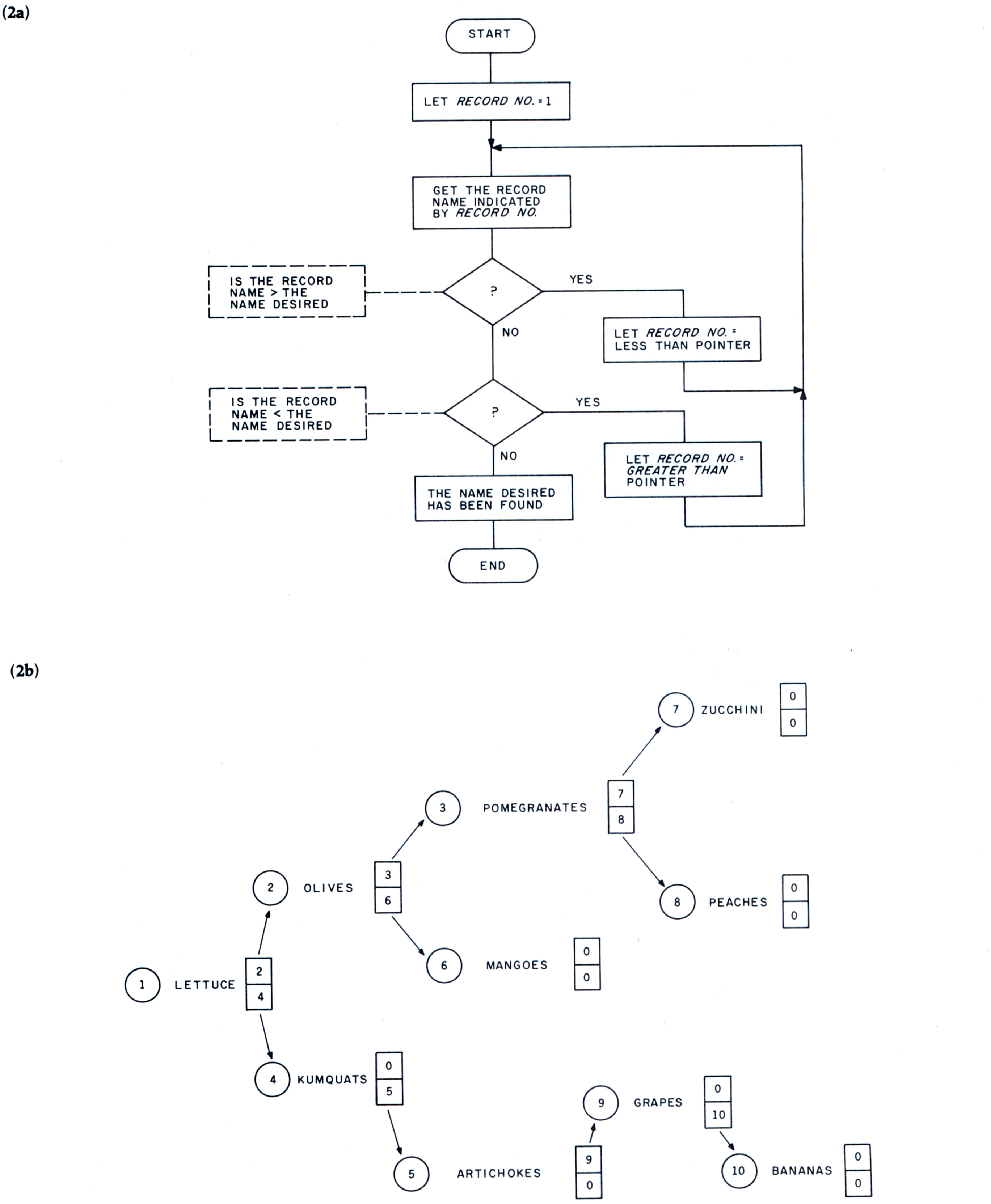

(2a)
START
LET RECORD NO. = 1
GET THE RECORD NAME INDICATED BY RECORD NO.
IS THE RECORD NAME > THE NAME DESIRED
?
YES
NO
LET RECORD NO. = LESS THAN POINTER
IS THE RECORD NAME < THE NAME DESIRED
?
YES
NO
LET RECORD NO. = GREATER THAN POINTER
THE NAME DESIRED HAS BEEN FOUND
END
(2b)
1 LETTUCE 2 4
2 OLIVES 3 6
3 POMEGRANATES 7 8
4 KUMQUATS 0 5
5 ARTICHOKES 9 0
6 MANGOES 0 0
7 ZUCCHINI 0 0
8 PEACHES 0 0
9 GRAPES 0 10
10 BANANAS 0 0

Figure 2: *Traversing the PDQ tree. Figure 2a is the flowchart for a method of searching a tree. Note its simplicity when compared to the binary-search method of figure 1a; searching the tree requires fewer steps and calculations. A sample PDQ tree (of the same data used in figure 1b) is shown in figure 2b.*

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Listing 1: *The PDQ Key-File System for the Radio Shack TRS-80 Model III. This program both creates and searches the PDQ tree for files of moderate length. The program should be easily portable for any computer using a form of Microsoft BASIC.*

```
P SWANSON   -   PDQ KEY FILE SYSTEM


      ---- SAMPLE INVENTORY PROGRAM USING KEY FILE SYSTEM ----

10 CLEAR 3000
15 DIMCA(6)
20 OPEN"R",1,"NEWFILE:0":    '*** NEWFILE = NAME OF FILE ***
30 FIELD1,255ASB$
40 REM ********* PARAMETER ARRAY **********
50 REM *****  1 # RECORDS/BLOCK ***********
60 REM *****  2 RECORD LENGTH ************
70 REM *****  3 FIRST BYTE OF GR **********
80 REM *****  4 FIRST BYTE OF LR **********
90 REM *****  5 KEY LENGTH ***************
100 REM*****  6 # RECORDS IN FILE (MAX) ***
110 REM***********************************
120 RESTORE
130 FORI=1TO6
140 READCA(I)
150 NEXTI
160 DATA 8,30,6,8,5,199
199 REM**** 200 SELECTOR ****
200 CLS
210 PRINT"                 ** INVENTORY PROGRAM **"
220 PRINT
230 PRINT"  1. ADD A RECORD TO THE FILE"
240 PRINT"  2. EDIT A RECORD ON FILE"
250 PRINT"  3. PRINT FILE DUMP"
260 PRINT
270 INPUT" ENTER NUMBER OF YOUR SELECTION";N
280 IFN=27THEN400
290 ONNGOTO600,900,1400
300 GOTO270
399 REM**** 400 INITIALIZE FILES ****
400 CLS
410 PRINT"************FILE INITIALIZATION*********"
420 PRINT
430 PRINT"ENTER PASSWORD:";
440 P$=""
445 CC=0
450 Q$=INKEY$:IFQ$=""THEN450
460 IFQ$=CHR$(13)THEN500
470 PRINT"X";
480 P$=P$+Q$
490 GOTO450
500 IFP$="SECRET"THEN510:ELSE200
510 B1$=STRING$(255,32)
520 FORI=1TO25
530 LSETB$=B1$
540 PUT1,I
550 NEXTI
560 MID$(B1$,1,2)=MKI$(0)
570 LSETB$=B1$
580 PUT1,1
590 GOTO200
599 REM**** 600 ADD A RECORD TO THE FILE ***
600 CLS
610 PRINT"                 ** ADD A RECORD TO THE FILE **"
620 PRINT
630 INPUT"ITEM NUMBER";I$
640 A$=I$
650 GOSUB7000
```

Listing 1 continued on page 246

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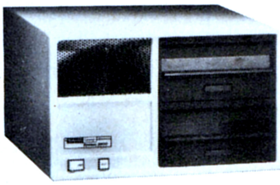

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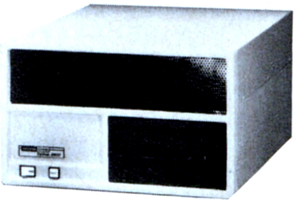
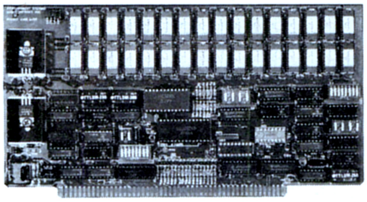


S-100 PRODUCTS



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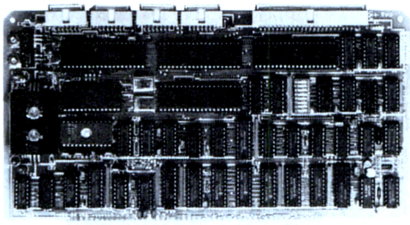

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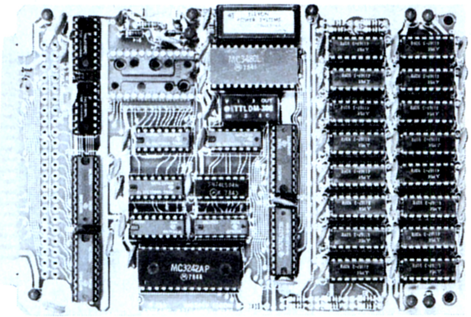

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Listing 1 continued:

```
660 IFE=0THENPRINT"DUPLICATE - KEY ALREADY IN FILE":GOTO2000
670 INPUT"DESCRIPTION";D$
680 INPUT"QUANTITY IN STOCK";Q
690 INPUT"UNIT PRICE";P
700 INPUT"ARE ALL VALUES CORRECT (Y/N)";Q$
710 IFQ$="N"THEN600
720 IFQ$<>"Y"THEN700
730 PRINT"***** SAVING RECORD IN THE FILE *****"
740 A$=STRING$(CA(2),32)
750 MID$(A$,1,5)=I$
760 MID$(A$,10,14)=D$+STRING$(14,32)
770 MID$(A$,24,2)=MKI$(Q)
780 MID$(A$,26,4)=MKS$(P)
790 GOSUB6000
800 GOTO200
899 REM**** 900 EDIT A RECORD ON FILE ****
900 CLS
910 PRINT"                ** EDIT RECORDS ON FILE **"
920 PRINT
930 INPUT"ENTER ITEM NUMBER OR END";I$
940 IFI$="END"THEN200
950 A$=I$
960 GOSUB7000
970 IFE=0THEN1000
980 PRINT"ITEM NOT IN FILE"
990 GOTO930
1000 I$=LEFT$(A1$,5)
1010 D$=MID$(A1$,10,14)
1020 Q=CVI(MID$(A1$,24,2))
1030 P=CVS(MID$(A1$,26,4))
1040 CLS
1050 PRINT"***** EDITING ITEM NUMBER ";I$
1060 PRINT
1070 PRINT"ENTER";TAB(15);"TO CHANGE";TAB(40);"CURRENT VALUE"
1080 PRINT"  -1";TAB(15);"TO QUIT AND NOT POST CHANGES"
1090 PRINT"   0";TAB(15);"TO END AND SAVE CHANGES"
1100 PRINT"   1";TAB(15);"DESCRIPTION";TAB(40);D$
1110 PRINT"   2";TAB(15);"QUANTITY";TAB(40);Q
1120 PRINT"   3";TAB(15);"UNIT PRICE";TAB(40);:PRINTUSING"####.##";P
1130 PRINT
1140 INPUT" ENTER NUMBER OF YOUR CHOICE FROM ABOVE LIST";N
1150 ONN+2GOTO900,1160,1290,1310,1330
1155 GOTO1140
1160 A$=STRING$(CA(2),32)
1170 MID$(A$,1,5)=I$+STRING$(5,32)
1180 MID$(A$,6,2)=MKI$(GR)
1190 MID$(A$,8,2)=MKI$(LR)
1200 MID$(A$,10,14)=D$+STRING$(14,32)
1210 MID$(A$,24,2)=MKI$(Q)
1220 MID$(A$,26,4)=MKS$(P)
1230 GOSUB5500
1240 B1$=B$
1250 MID$(B1$,CA(2)*(RN-1)+1,CA(2))=A$
1260 LSETB$=B1$
1270 PUT1,BN
1280 GOTO900
1290 INPUT"NEW DESCRIPTION";D$
1300 GOTO1040
1310 INPUT"NEW QUANTITY";Q
1320 GOTO1040
1330 INPUT"NEW UNIT PRICE";P
1340 GOTO1040
1399 REM**** 1400 PRINT INVENTORY LISTING ****
1400 CLS
1410 PRINT"                ** INVENTORY LISTING **"
1420 PRINT
```

Listing 1 continued on page 248

8089 I/O Processor Handbook
Includes 8289 Bus Arbiter
68000 Microprocessor Handbook
Gerry Kane
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Listing 1 continued:

```
1430 INPUT"START AT ITEM";SI$
1440 INPUT"END AT ITEM";EI$
1450 IFSI$>EI$THEN1430
1452 SI$=SI$+STRING$(5,32)
1454 EI$=EI$+STRING$(5,32)
1460 IFSI$>STRING$(5,32)THENMID$(SI$,5,1)=CHR$(ASC(MID$(SI$,5,1))-1)
1470 L9=55:P9=0
1475 TV#=0
1480 A$=SI$
1490 GOSUB8000
1500 IFE<>0THEN1690
1510 IFLEFT$(A1$,5)>LEFT$(EI$,5)THEN1690
1520 L9=L9+1
1530 IFL9<55THEN1590
1540 IFP9<>0THENFORI=L9TO65:LPRINT" ":NEXTI
1550 P9=P9+1
1560 LPRINT"               INVENTORY LISTING REPORT           PAGE";P9
1570 LPRINT" "
1575 LPRINT"ITEM NO.";TAB(10);"DESCRIPTION";TAB(30);"QUANTITY";TAB(45);"UNIT PRI
CE";TAB(60);"EXT. VALUE"
1580 L9=4
1590 Q=CVI(MID$(A1$,24,2))
1600 P=CVS(MID$(A1$,26,4))
1610 LPRINTLEFT$(A1$,5);TAB(10);MID$(A1$,10,14);TAB(30);
1620 LPRINTUSING"#####";Q;:LPRINTTAB(45);
1630 LPRINTUSING"####.##";P;:LPRINTTAB(60);
1640 EV#=Q*P
1650 TV#=TV#+EV#
1660 LPRINTUSING"#,###,###.##";EV#
1670 A$=A1$
1680 GOTO1490
1690 LPRINT" "
1700 LPRINT"TOTAL VALUE OF INVENTORY =";
1710 LPRINTUSING"#,###,###.##";TV#
1720 GOTO200
2000 INPUT"PRESS ENTER WHEN FINISHED VIEWING";Q$
2010 GOTO200
4998 STOP
4999 REM**** GET NEXT FREE RECORD - FR ****
5000 GET1,1
5010 FR=CVI(LEFT$(B$,2))+1:       '--- Record 0, bytes 1 & 2 ---
5020 B1$=B$:                      '--- contain the count of  ---
5030 MID$(B1$,1,2)=MKI$(FR):      '--- records used.  FR is  ---
5035 LSETB$=B1$:                  '--- next available rec. # ---
5040 PUT1,1
5050 RETURN
5499 REM**** 5500 GET RECORD #RR - A1$ ****
5500 BN=INT(RR/CA(1)):            '--- BN = block no.        ---
5510 RN=RR-BN*CA(1)+1:            '--- RN = reference on block--
5520 BN=BN+1
5530 GET1,BN
5540 A1$=MID$(B$,CA(2)*(RN-1)+1,CA(2))
5560 GR=CVI(MID$(A1$,CA(3),2)):   '--- GR = greater reference---
5570 LR=CVI(MID$(A1$,CA(4),2)):   '--- LR = lesser reference ---
5580 RETURN
5999 REM**** 6000 PUT RECORD A$ INTO FILE ****
6000 GOSUB5000:                   '--- Get next free record  ---
6010 IFFR>1THEN6100:              '--- The first record gets ---
6015 A1$=A$+STRING$(CA(2),32):    '--- special treatement.   ---
6020 A$=LEFT$(A1$,CA(2)):         '--- Pack A$...            ---
6022 MID$(A$,CA(3),2)=MKI$(0)
6024 MID$(A$,CA(4),2)=MKI$(0)
6030 RR=FR:                       '--- Set record number (=1)---
6040 GOSUB5500:                   '--- Get record.           ---
6050 B1$=B$
6060 MID$(B1$,CA(2)*(RN-1)+1,CA(2))=A$
```

Listing 1 continued on page 250

Circle 427 on inquiry card. →

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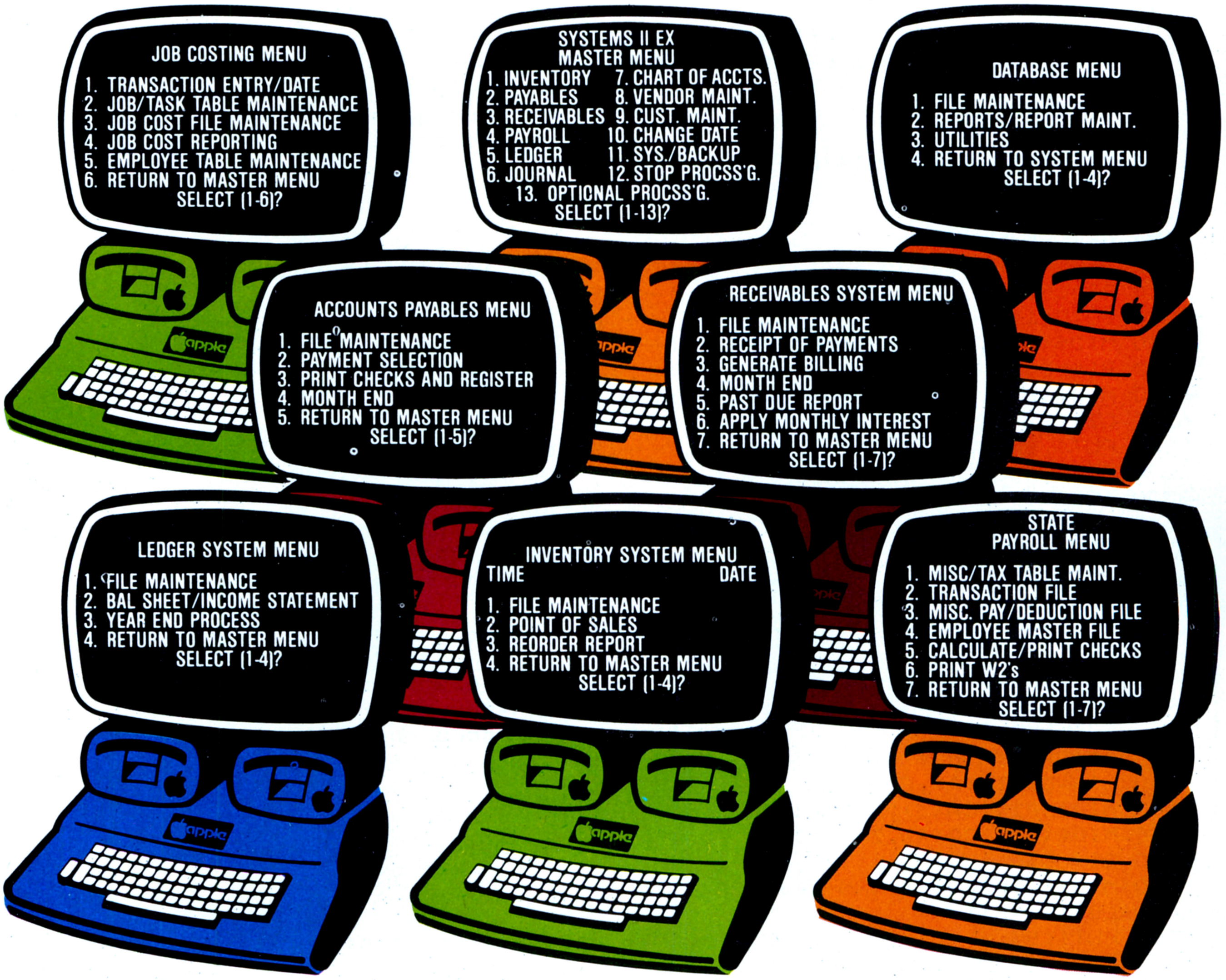
JOB COSTING MENU
1. TRANSACTION ENTRY/DATE
2. JOB/TASK TABLE MAINTENANCE
3. JOB COST FILE MAINTENANCE
4. JOB COST REPORTING
5. EMPLOYEE TABLE MAINTENANCE
6. RETURN TO MASTER MENU
SELECT (1-6)?
SYSTEMS II EX
MASTER MENU
1. INVENTORY 7. CHART OF ACCTS.
2. PAYABLES 8. VENDOR MAINT.
3. RECEIVABLES 9. CUST. MAINT.
4. PAYROLL 10. CHANGE DATE
5. LEDGER 11. SYS./BACKUP
6. JOURNAL 12. STOP PROCSS'G.
13. OPTIONAL PROCSS'G.
SELECT (1-13)?
DATABASE MENU
1. FILE MAINTENANCE
2. REPORTS/REPORT MAINT.
3. UTILITIES
4. RETURN TO SYSTEM MENU
SELECT (1-4)?
ACCOUNTS PAYABLES MENU
1. FILE MAINTENANCE
2. PAYMENT SELECTION
3. PRINT CHECKS AND REGISTER
4. MONTH END
5. RETURN TO MASTER MENU
SELECT (1-5)?
RECEIVABLES SYSTEM MENU
1. FILE MAINTENANCE
2. RECEIPT OF PAYMENTS
3. GENERATE BILLING
4. MONTH END
5. PAST DUE REPORT
6. APPLY MONTHLY INTEREST
7. RETURN TO MASTER MENU
SELECT (1-7)?
LEDGER SYSTEM MENU
1. FILE MAINTENANCE
2. BAL SHEET/INCOME STATEMENT
3. YEAR END PROCESS
4. RETURN TO MASTER MENU
SELECT (1-4)?
INVENTORY SYSTEM MENU
TIME DATE
1. FILE MAINTENANCE
2. POINT OF SALES
3. REORDER REPORT
4. RETURN TO MASTER MENU
SELECT (1-4)?
STATE
PAYROLL MENU
1. MISC/TAX TABLE MAINT.
2. TRANSACTION FILE
3. MISC. PAY/DEDUCTION FILE
4. EMPLOYEE MASTER FILE
5. CALCULATE/PRINT CHECKS
6. PRINT W2's
7. RETURN TO MASTER MENU
SELECT (1-7)?
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Listing 1 continued:

```
6070 LSETB$=B1$:                 '--- Insert new record,    ---
6080 PUT1,1:                     '--- & put it in the file. ---
6090 E=0:RETURN
6100 RR=1:                       '--- Start search with # 1.---
6102 IFFR<=CA(6)THEN6110:        '--- Check for end of file.---
6104 E=2:RETURN
6110 GOSUB5500:                  '--- Get record no. RR     ---
6120 IFLEFT$(A$,CA(5))<LEFT$(A1$,CA(5))THEN6200
6130 IFLEFT$(A$,CA(5))>LEFT$(A1$,CA(5))THEN6300
6140 E=1:                        '--- Equal - duplicate key ---
6142 GET1,1:                     '--- Restore original value---
6144 B1$=B$:                     '--- of record counter     ---
6146 MID$(B1$,1,2)=MKI$(FR-1)
6148 LSET B$=B1$
6150 PUT1,1
6152 RETURN
6200 IFLR=0THEN6240:             '--- Branch if no more recs---
6210 RR=LR:                      '--- RR= next to search    ---
6220 GOTO6110:                   '--- Continue searching.   ---
6240 MID$(A1$,CA(4),2)=MKI$(FR): '--- Spot found - pack loc.---
6250 B1$=B$
6260 MID$(B1$,CA(2)*(RN-1)+1,CA(2))=A1$
6270 LSETB$=B1$
6280 PUT1,BN:                    '--- Save pointer record   ---
6290 GOTO6400
6300 IFGR=0THEN6340:             '--- Branch if no more recs---
6310 RR=GR:                      '--- RR= next to search    ---
6320 GOTO6110:                   '--- Continue searching.   ---
6340 MID$(A1$,CA(3),2)=MKI$(FR): '--- Spot found - pack loc.---
6350 B1$=B$
6360 MID$(B1$,CA(2)*(RN-1)+1,CA(2))=A1$
6370 LSETB$=B1$
6380 PUT1,BN:                    '--- Save pointer record   ---
6400 RR=FR:                      '--- RR now=new record no. ---
6420 GOSUB5500:                  '--- Load record space...  ---
6430 A$=A$+STRING$(CA(2),32):    '--- Init.& pack new record---
6440 A1$=LEFT$(A$,CA(2))
6442 MID$(A1$,CA(3),2)=MKI$(0)
6444 MID$(A1$,CA(4),2)=MKI$(0)
6450 B1$=B$
6460 MID$(B1$,CA(2)*(RN-1)+1,CA(2))=A1$
6470 LSETB$=B1$
6480 PUT1,BN:                    '--- and save it on disk.  ---
6490 E=0:RETURN
6999 REM**** 7000 GET RECORD A$ FROM FILE ****
7000 RR=1:                       '--- Start with first rec. ---
7010 GOSUB5500:                  '--- Get record from file  ---
7020 IFLEFT$(A$,CA(5))<LEFT$(A1$,CA(5))THEN7100
7030 IFLEFT$(A$,CA(5))>LEFT$(A1$,CA(5))THEN7200
7040 E=0:                        '--- Equal - record found  ---
7050 RETURN
7100 IFLR=0THENE=1:RETURN:       '--- Not found             ---
7110 RR=LR:                      '--- Cont. search at # LR  ---
7120 GOTO7010
7200 IFGR=0THENE=1:RETURN:       '--- Not found             ---
7210 RR=GR:                      '--- Cont. search at # GR  ---
7220 GOTO7010
7999 REM**** 8000 GET NEXT GREATER KEY ****
8000 A$=A$+STRING$(CA(2),32):    '--- Incr. last byte of key ---
8005 MID$(A$,CA(5),1)=CHR$(ASC(MID$(A$,CA(5),1))+1)
8010 A2$=STRING$(CA(5),255):     '--- Initialize indicator  ---
8020 RR=1:                       '--- Begin search at no. 1 ---
8030 GOSUB5500:                  '--- Get record & compare  ---
8040 IFLEFT$(A$,CA(5))<LEFT$(A1$,CA(5))THEN8100
8050 IFLEFT$(A$,CA(5))>LEFT$(A1$,CA(5))THEN8200
8060 E=0:                        '--- Found directly.
```

Listing 1 continued on page 252

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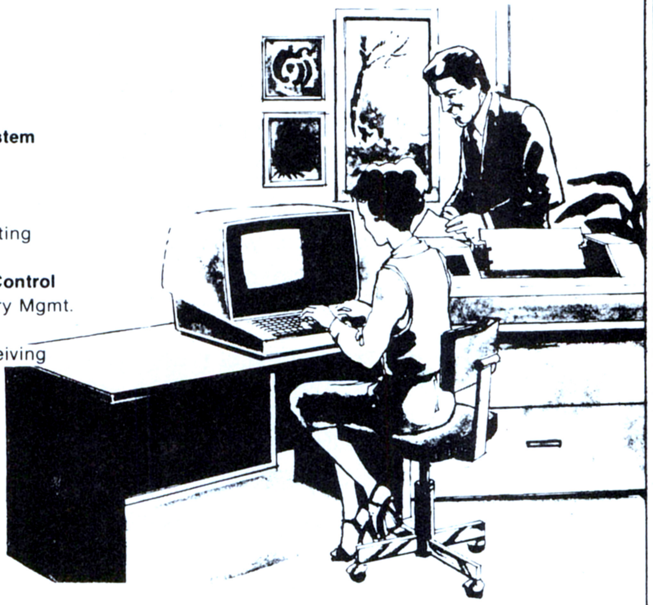

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Listing 1 continued:

```
8070 RETURN
8100 IFLEFT$(A1$,CA(5))<LEFT$(A2$,CA(5))THENA2$=A1$
8110 IFLR>0THEN8150:             '--- Check for end of search--
8120 A1$=A2$:                    '--- A2$ holds next greater---
8130 IFLEFT$(A1$,1)=CHR$(255)THENE=1:ELSEE=0
8140 RETURN
8150 RR=LR:                      '--- Continue at rec no. LR---
8160 GOTO8030
8200 IFGR>0THEN8250:             '--- Check for end of search--
8210 GOTO8120:                   '---- Borrow a few statements--
8250 RR=GR:                      '--- Continue at rec no. GR---
8260 GOTO8030
```

Text continued from page 240:

zero. This is the first record in the file, physically, and is numbered zero by the way the mathematics of the next subroutine work. This first subroutine simply loads the value, increments it, then resaves it, storing the value of the record in the variable FR (for "free record").

The second subroutine, starting at line 5500, finds a record by number and loads it into memory as the variable A1$. The record number is assumed to be in the variable RR. Since this subroutine set allows for more than one record per file block, a few formulas are required. Lines 5500 through 5520 calculate the number of the block and the relative number (ie: number of the record on the block) of the record. Line 5540 extracts the correct part of the buffer (B$) for the record. Lines 5560 and 5570 "decode" the two greater than and less than pointers so that the other subroutines don't have to deal with that job.

These first two subroutines are there to simply help the other ones. They can be used in any random-access file (except for the unpacking of GR and LR). The rest of the subroutines handle the actual logic of the system.

Line 6000 starts the subroutine that puts a new record into the file. If it is the very first record, it is simply saved as record number one and the two pointers are both set to zero. This happens in lines 6015 through 6090. The subroutine that gets the number of the next available record (line 5000) is used in this subroutine.

If it is not the first record, then a more complicated solution is required; this begins at line 6100. First, the file must be searched for the alphabetical position of the new record. Start with record number one (see line 6100). Before the routine goes any further, it tests the record number to see if there is any more room in the file. If there isn't, then there is no reason to go any further, because the record cannot be added to the file. Note the use of the variable E. This is used as a form of error code. If, when the subroutine returns, E is 0, then everything went as planned. If E is returned as 2 it means that the file is full and the record is not saved. If E is 1, the key is already in the file and the new record is not saved. This will come up later in this subroutine.

The search is somewhat like the binary search. The record is looked up in line 6110, which uses the subroutine at line 5500. Lines 6120 and 6130 test to see which is greater. These branch to other parts of this subroutine. If these two tests "fall through," the record has a key equal to the one to be inserted. Lines 6140 through 6152 take care of this situation. First, E is set to 1 to indicate the error. Next, since the record number

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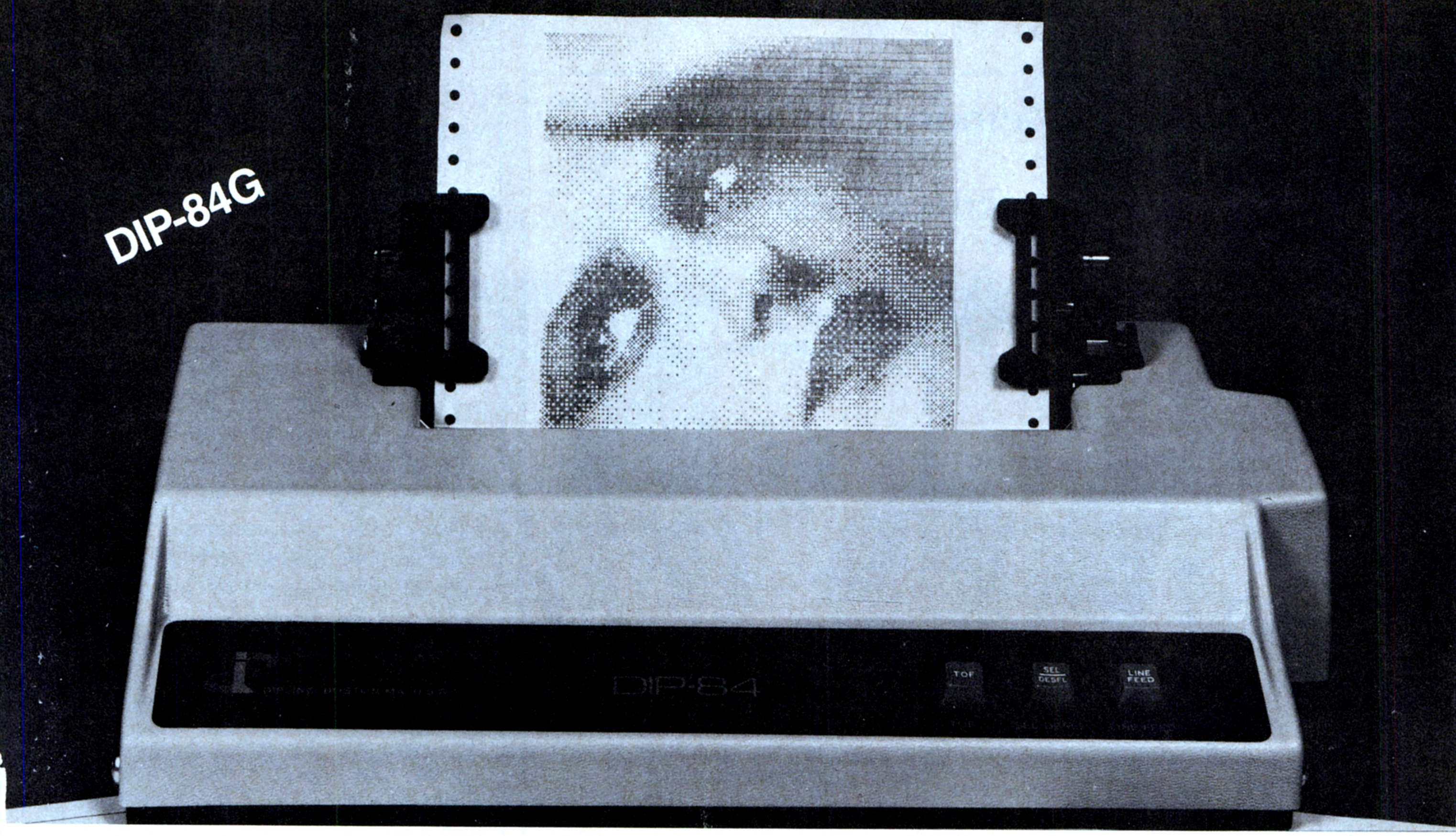

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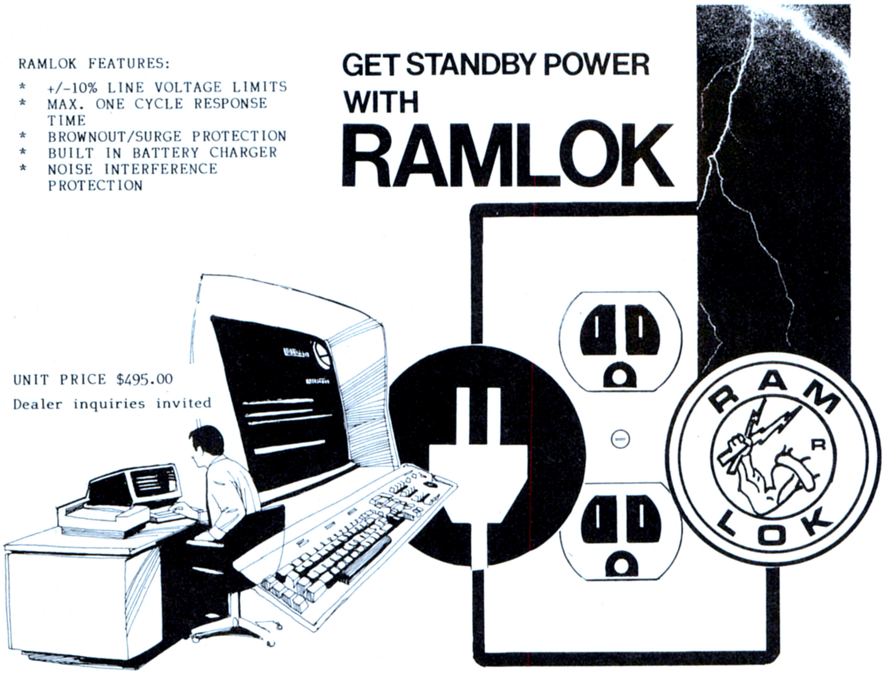

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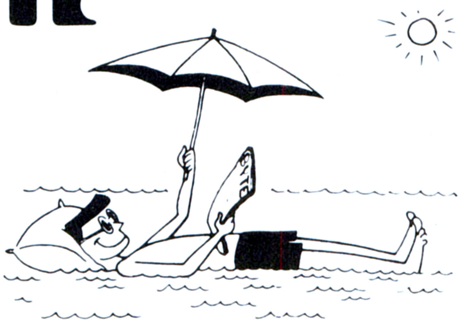

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will not be used, the value of the variable used to count the number of records used must be restored. It was incremented by the GOSUB 5000, so lines 6142 through 6150 decrement it, then 6152 returns to the main program.

If the key to be inserted is less than the key in the record just loaded, line 6120 branches to line 6200. If there are no records indicated by the variable LR (ie:, LR=0), then the spot to link up this new record is found and line 6200 branches to line 6240. If LR does contain a record number, then RR, which is the record number to test, is set to this pointer (LR), and the routine returns to line 6110 to continue the search.

Line 6240 begins the section of program that inserts the record when it is less than the last one found in the search. The *less than* pointer is updated in lines 6240 through 6260 so that it will point to the new record. It is resaved in line 6270, then the routine branches to line 6400 to pack and save the new record.

Between line 6290 and that routine in line 6400 is the routine that handles the situation where the record to be inserted is greater than the record being tested in the search. Line 6130 tests this and branches to line 6300 if the condition is true. This is almost the same as the routine just described that starts at line 6200. The difference is that GR is the pointer used instead of LR.

Line 6400 packs and saves the new record. By the time the routine gets to this line, the record that points to it has been updated. This part of the program just sets up the record and saves it on disk. E is set to 0 just before the RETURN statement to indicate that all went well.

The other two subroutines are variations of the search described for the subroutine that puts a new record into the file. The subroutine starting at line 7000, which gets a record from the file given the key, is the search with the values of the error code (the variable E) set to 0 if the record is found and to 1 if it is not in the file.

The last subroutine allows the reports to be in alphabetical order. It will take a key and find the next one

Circle 416 on inquiry card. ⟶

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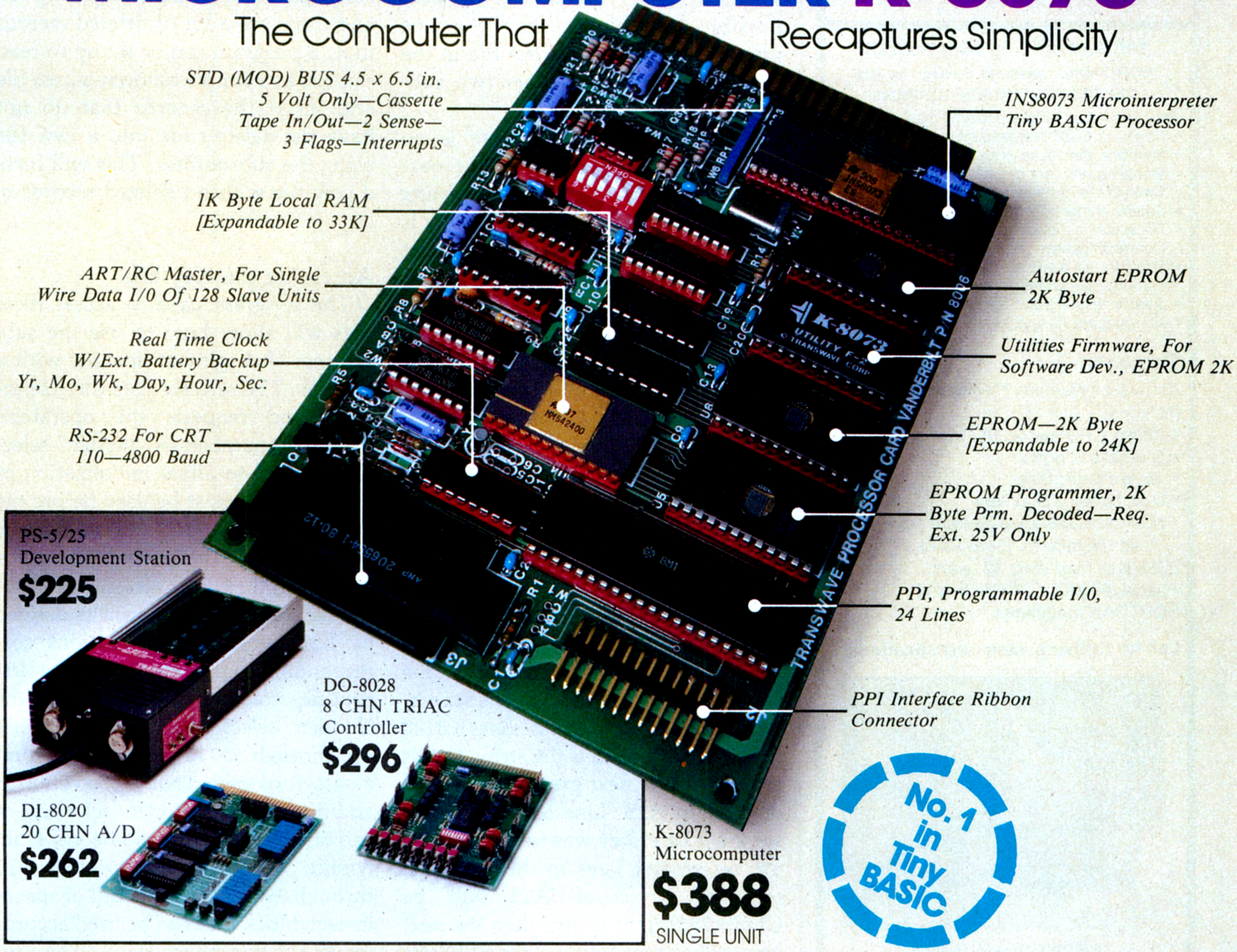
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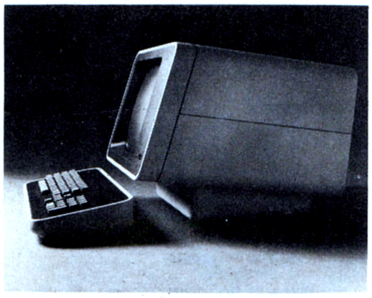

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in the file that is greater. How it works is fairly simple. It first increments the value of the last byte in the key, which makes it the next possible key higher than the one given. It then searches the file in the same manner as the other two subroutines.

If the key is found, there is no problem. The key found is the next higher key in the file. The interesting part is the condition where the key is not found. The key found may not be the next greater key (the "key found" meaning the last one tested in the search). A2$ is used to locate the next greater key. It is initially set to the highest possible value for a string (ASCII code 255). When, in the process of searching, the key loaded is greater than the key being searched (which causes line 8040 to branch to line 8120), the key loaded may be the correct one. It is greater than the one being searched. If it is also less than A2$, then line 8100 sets A2$ equal to it.

The rest of the searching is the same except for the end of the search, which is handled by lines 8120 through 8140. A1$ is the string that is to contain the next greater record, so it is set to A2$. Line 8130 checks to see if a greater key was found. If there are no greater keys in the file, then the first byte of A1$ will be CHR$(255). If it is not, then the next greater key was found. Line 8130 sets E equal to 1 if there are no greater records in file and to 0 if the next greater record is found and returned in A1$.

Deleting Keys

This is the simplest key-file system I know. Like the bubble sort, it is slower than other methods, but is so much simpler to program that it is hard to pass it up in favor of other methods. One drawback, however, is not easy to ignore: there is no way to delete a key. This is due to the pointers. Unless the key was at the end of one of the branches (ie:, both pointers were zero), deleting it would involve changing the pointers of many records. This would be a complicated routine.

A simple solution is to insert a code in the record of a deleted key, leaving the pointers and key intact so that the key will not interfere with future searches. When the file is getting full and there are a lot of deleted records in it, a program can be set up to read this file as a simple random-access file and insert the records that do not have the delete code into a new file using the subroutines. This will form a new file with no deleted records in it.

Accessing the Key File

The program used to access these files will show how to use the subroutines. It begins at line 200 with a selector. The selector lists three selections and requests the operator's choice by number. A "hidden" selection is used to allow initialization of the file. This must be used before the first record is entered and can be used at any time to wipe out all of the records in the file and start out fresh.

The rest of the program is divided by line number into functions corresponding to the selections. The first routine, starting at line 400, is the "hidden" selection (number 27). Lines 430 through 500 request and interpret a password so that some protection in addition to the hidden selection is provided to prevent someone from wiping out your data. Lines 510 through 590 save blocks full of spaces in each block that can be used according to the parameter array. The program then saves a 0 in the first two bytes of record number 0 so that the subroutine at line 5000 can use it as the record counter.

The function starting at line 600 allows the addition of a new record into the file. In this example, the key is the item number and that is requested first. Next, the function uses the subroutine starting at line 7000, which gets the record given the key. If this subroutine finds the key and returns E equal to 0, then the key is already in the file. This causes the error message to be displayed. If it is not found (E=1), then the function proceeds to request the information you want the record to contain. When this has been entered, lines 730 through 790 pack it all into the string A$ and call the subroutine starting at

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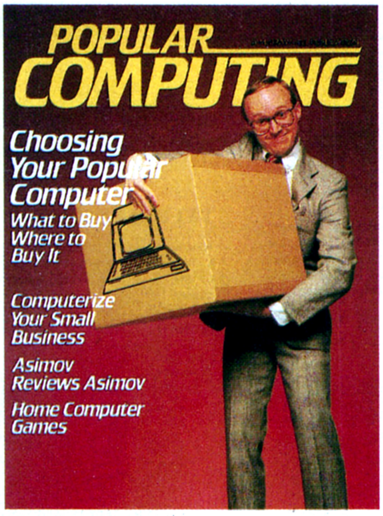

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line 6000 to insert this new record into the file. Note that there is no check for the error code E if E is equal to 1, which indicates that this is a duplicate key, because that was already checked by the subroutine called in line 650. There is a need to check for the end-of-file condition where E is equal to 2. This could be added to the function at this point.

The fields in the file are shown in table 1, which is a data-file layout form. This table shows the variables that the values will be stored in when the record is in the memory and where each field is packed in the record. The information on this sheet is used to determine much of the in-

DATA FILE LAYOUT

FILE *NEWFILE* — *Inventory file to test subroutines*
FILE TYPE *Key* ACCESS BY *Item Number*

VARIABLE	START	LENGTH	PACK	DESCRIPTION
I$	1	5	Integer	Item no. (key)
GR	6	2	Integer	Greater pointer
LR	8	2	Integer	Lesser pointer
D$	10	14	Alphanumeric	Description
Q	24	2	Integer	Quantity
P	26	4	Single precision	Unit Price

Total Rec. Length = 30
Rec./block = 255/30 = 8
First byte of GR = 6
First byte of LR = 8
Key Length = 5
Rec. in file = 199

Table 1: *A data-file layout form. It shows the variables that the values will be stored in when the record is in the memory and where each field is packed in the memory.*

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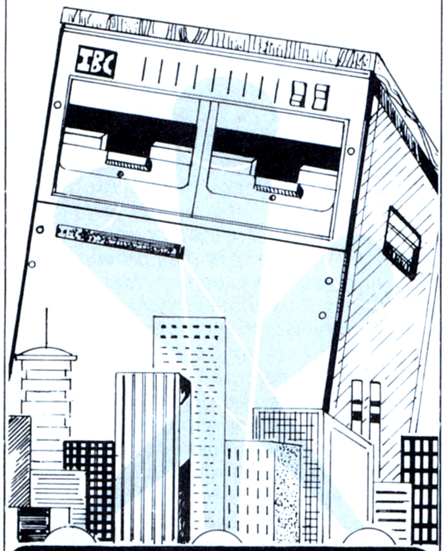

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Glossary

Array: *A list or table for holding data in such a way that each datum may be accessed by one or two index numbers.*

Binary search: *A method of searching an ordered list for a test value by comparing the test value with the value located at the middle of the list. This procedure effectively divides the list into two sections, and the search proceeds in the section having the value being tested for by, again, comparing the test value with the value located at the middle of the section.*

Character: *A number or symbol that represents some amount (usually 8 bits) of information.*

Fields: *A region of data within a record that refers to the same general properties as corresponding regions in other records.*

Hashing: *A method of searching a list by using a portion of the test value as an index.*

Key: *The field of a record that may be compared with a test value.*

Pointer: *A variable or memory location whose value is the address of a memory location.*

Random-access file: *A disk file whose records may be read in any order.*

Records: *Divisions of data in a file such that each of the divisions contains the same type of information at corresponding positions.*

Search: *To examine a file to locate certain information.*

Sequential file: *A disk file whose records may be read only in sequential order.*

Sort: *To put the records of a file in order according to the data they contain.*

Test value: *The information that a file is being searched for.*

formation required in the parameter array.

The next function, which starts at line 900, allows you to change data in records that have already been saved in the file. Lines 900 through 1030 get the item number to edit, load, and unpack the record, and perform some checking concerning the key entered. The checking consists of two parts. The first allows an "escape" from the function. If the key entered is "END," the function branches back to the selector. The second check is if the record is in the file. If it is not, the message at line 980 is displayed. The checking is on the error code E after the GOSUB 7000.

The rest of this function could take many different forms. The one I used here allows the operator to select, by number, 1, 2, or 3 for the field to edit, 0 to end editing and resave the record, or −1 to end the edit of this item and not post any changes. A −1 simply causes a branch back to the beginning of the function. The 0 is handled in lines 1160 through 1280. Lines 1160 through 1220 repack the fields into the string A$. In order to resave the record, this function first reloads it (the "old" version before the changes were made), then replaces the area in the buffer with the new version of the record.

The last function, the printout, uses the "get next higher key" subroutine. This function begins at line 1400. Lines 1430 and 1440 request the starting and ending keys for the listing. After these are checked (to make sure the starting key is not greater than the ending key), line 1460 decrements the first key. The listing will be in alphabetical order by continually calling the subroutine starting at line 8000, which gets the next higher key. By decrementing the first key, the first key that will be printed could be the key entered, if it is in the file. If this decrementing were not done, and the starting key were a key in the file, the function would start with the next greater key rather than the one entered.

The part of this function that controls which key is to be printed is in lines 1490 and 1500: 1490 gets the next greater key and line 1500 checks for the end-of-file condition. Added

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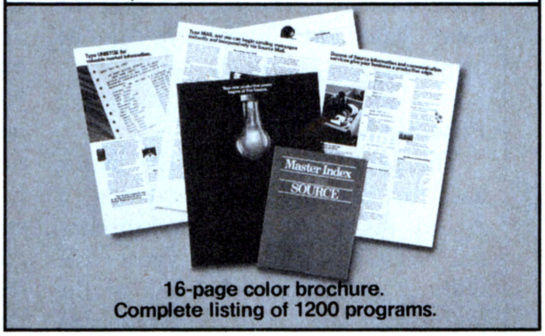

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Recommended Reading

In 1973, Donald E Knuth of Stanford University produced what must be the definitive work on computer-programming techniques: The Art of Computer Programming *(Addison-Wesley). It is a set of three volumes covering nearly every useful software trick, and it rates many varied competing techniques to show what works best under given circumstances.*

Because the computer's main purpose is to keep, sort, and search lists of data (just as the wheel's reason for being is to roll), a large portion of Knuth's work is dedicated to the storage, arrangement, and selection of data. I especially recommend:

Volume 1, Fundamental Algorithms
  Chapter 2, Information Structures (page 228)
Volume 3, Sorting and Searching
  Chapter 5.2, Internal Sorting (page 73)
  Chapter 5.3, Optimum Sorting (page 181)
  Chapter 6, Searching
    section 6.2.1 Searching an Ordered Table (page 406)
    section 6.2.2 Binary-Tree Searching (page 422)

to this control is the logic in line 1510, which checks that the new key is not greater than the ending key, and line 1670, which places the last key printed into A$ for the next search.

The remaining statements simply format the output. Added to the function for the inventory application is the extended value, which is the quantity times the unit price. This is accumulated in line 1650 so that the total value of inventory can be printed at the end of the report.

Possible Modifications

The program given in the listing has no provision for deleting a record. As noted above, a key cannot be deleted from this type of file without extensive reshuffling of the pointers. A few simple alterations can add this function.

The file layout must be altered first to add a one-byte field that is to serve as the delete code. For all active, not-deleted records, this field can store the letter A. When a record is deleted, use it to store the letter D. The easiest way to do this is to shorten the description by one byte and put the code where the last byte of the description was.

Change the two packing routines to reflect this adjustment. There is one in the input section starting at line 740 and there is another one in the edit section starting at line 1160. Also change the printout section at line 1610. Additional changes will also be required to check this byte in the edit and report sections so that a deleted record will not be edited or printed.

In the input section, you may want to introduce some way to change the delete status if the user enters the key of a deleted record. This could be part of the edit function, where it would be easier to program, but it would be easier for the user if it was added to the input section.

The subroutines are fairly short, but they can be made even shorter by combining some code. This is a fairly new subroutine set for me, so it has not been subjected to any refinement. It has passed several tests, but it may still have some bugs. One obvious part of the program that can be shortened is to replace lines 6015 through 6090 with a GOTO 6400. Although the variable use is a little different, these routines do exactly the same thing. You may want to find some of these condensable parts or, since the subroutines work the way they are, you may want to use them without any changes.

The programming was done on a Radio Shack Model III system. Since this uses a form of Microsoft BASIC, adaptation of this program to other systems that also use Microsoft BASIC should not be a big problem. Adaptation to other types of BASIC may be a little more difficult. I hope the structure of the program and the remarks make this task easier for anyone attempting that. ■

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System Review

Orchestra-80

Elizabeth Cooper and Yvon Kolya
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Soon after the release of the Radio Shack TRS-80 microcomputer by the Tandy Corporation, programs promising to turn the TRS-80 into a music-producing instrument appeared. These programs used an AM radio to pick up and amplify the RFI (radio-frequency interference) given off by the Z80 microprocessor and its support devices. The RFI produced by carefully arranging routines executed by the computer played recognizable notes through the radio.

The disadvantages to this method were:

- the limited range of notes that could be produced
- the odd timbre of the notes
- distracting noises produced by the system were also played through the radio, usually at the same time as the notes

The next stage in this development involved the use of the cassette-data port. Specific notes were generated by mathematical algorithms. These notes were then sent to the cassette port of the computer, where they were either recorded on tape or played through a small audio amplifier.

This procedure produced a wider range of purer-sounding notes, but they sounded as if they were made by a toy electronic organ rather than by a true musical instrument. This was due to the circuitry used in the TRS-80 to process signals sent to the port.

Now, three years after its appearance on the market, it *is* possible to use the TRS-80 to its fullest capabilities in music generation.

The company responsible for this breakthrough is Software Affair Ltd. The product is Orchestra-80 (see photo 1).

Orchestra-80 claims to be a "unique combination of hardware and software that can turn any 16 K-byte TRS-80 (Model I) Level II into a high-quality musical instrument," and it is.

The hardware is a small circuit board soldered to a 40-pin edge-card connector that attaches to the TRS-80 expansion port, either on the computer keyboard unit or the expansion interface (see photos 2a and 2b). The circuit board has an RCA-type phono jack that can be connected to any hi-fi amplifier with an RCA-type patch cord. The circuit board is not an amplifier, but a buffering device between the TRS-80 and a hi-fi amplifier. This

At a Glance

Name
Orchestra-80

Type
music-generation software/hardware combination

Manufacturer
Software Affair Ltd
473 Sapena Ct, Suite 1
Santa Clara CA 95051
(408) 295-9195

Price
$79.95

Dimensions
2 by 1 by 1¾ inches (hardware)

Documentation
40-page manual

Format
cassette tape

Computer
TRS-80 Model I, Level II, 16 K programmable memory
TRS-80 disk-based Model I

Audience
music schools, teachers, students, and anyone interested in computer-generated music

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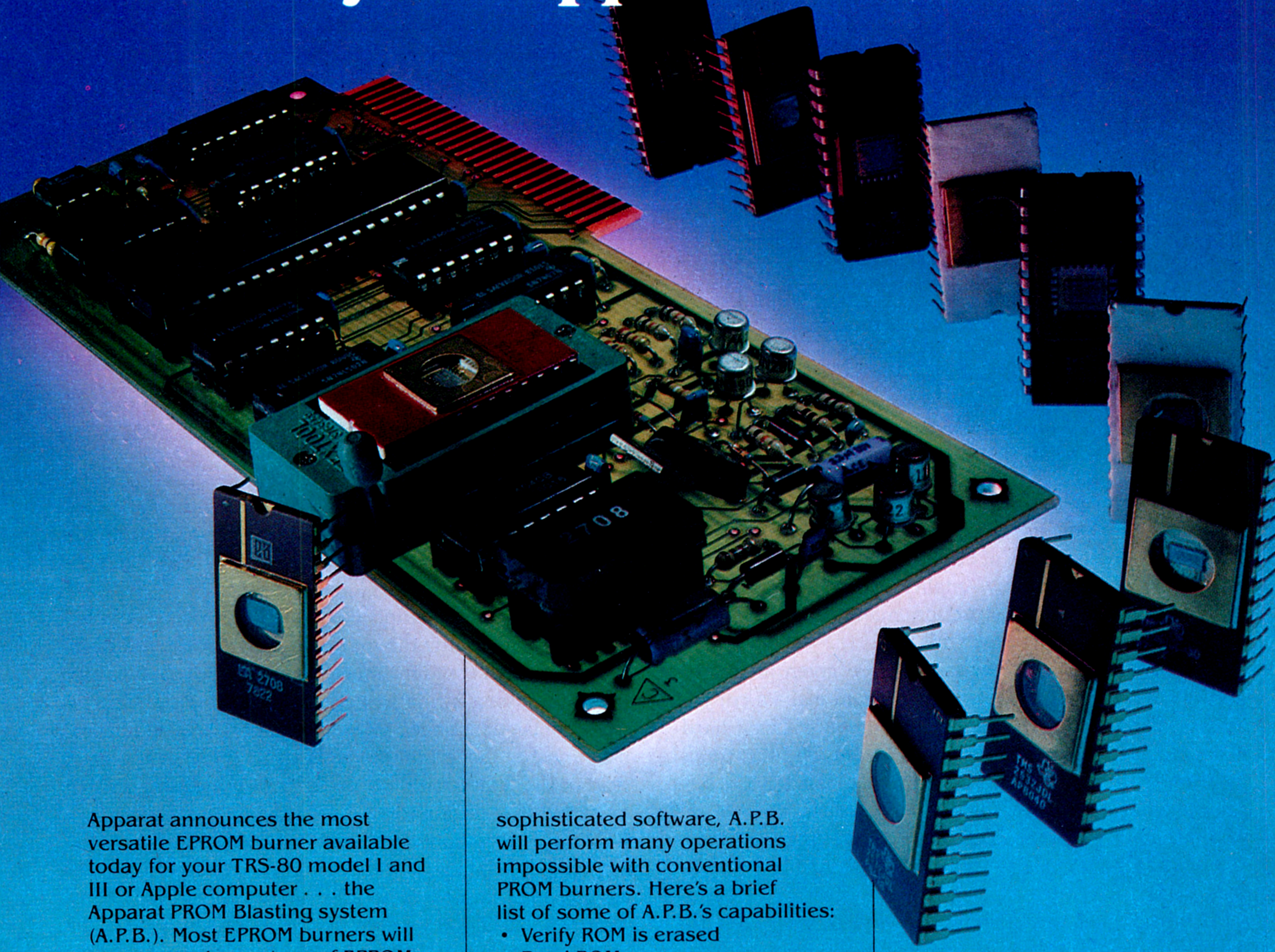

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- Copy between different ROM types
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- Partial programming and copies
- Verify programming
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- Examine and/or modify working memory
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*TRS-80 version requires the TRS-80 bus extender (Cat. # 1-025) or a separate user provided power supply and cable.

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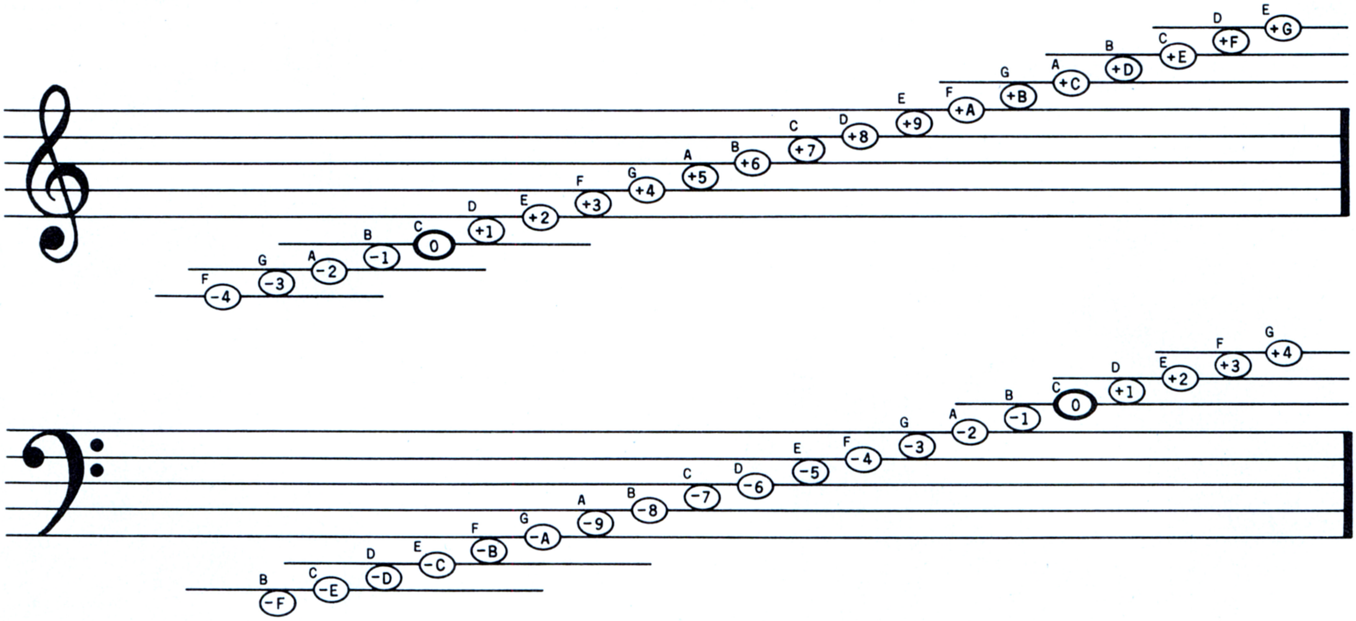

Figure 1: *The correspondence between standard music notation and the code used in Orchestra-80. This figure is on page 26 of the Orchestra-80 instruction manual.*

is one reason for the low cost of the package. Also, this approach lets you use your own high-quality amplifier and avoids the problem of choosing between high-quality sound/high price and low-quality sound/low price.

The software and instruction manual, on the other hand, are more impressive.

After loading the software, you are given an opportunity to have the Orchestra-80 program make a copy of itself. Then you are asked if your computer has a hardware clock speed modification. If it does, and this modification is under software control, you can tell Orchestra-80 what the enable and disable codes are for the changes in clock speed. The program will then automatically disable the clock whenever disk or tape I/O (input/output) is necessary.

The next question deals with whether you want the software to play in three or four voices. Four voices gives you greater flexibility in scoring music; three voices leaves you more memory in which to score music.

Next, you must decide if you want to modify the waveforms of the different registers (ie: voices). The waveform of a register is defined as a sum of sine waves or *partials*. The frequency of each partial is an integer multiple of the fundamental frequency of the register. Up to fifteen partials (also known as harmonics) can be specified, in addition to the fundamental frequency.

Once this has been done, you specify how much (from 0 to 255) each partial should contribute to the overall volume of the register. A value of 0 contributes nothing, while a value of 200 will be twice as loud as a value of 100. Finally, you select the overall volume of each register, as compared with the others.

With these preliminary steps completed, you are ready to begin playing with Orchestra-80.

If the instruction manual appears intimidating or overly complicated to the novice, it is largely because of its thoroughness. It leaves nothing out, from the necessary instructions about installing the hardware and configuring the software, to a section on "How it Works," and the sections on the music-language code.

Not only is the method of transcribing music covered in detail, telling how the music language of Orchestra-80 compares with standard music notation, but there is also a section giving a fine lesson in interpreting the Orchestra-80 music language, as well as understanding musical notation for those unfamiliar with it. Even if you can't read music, you should be able to transcribe most written music, with a little effort.

These instructions are well supplemented with examples and tables summarizing the instructions, including illustrations of written music and how it compares with the notation used by the computer. Two of the figures in the manual show J S Bach's *Capriccio* in standard music notation and in the code used by Orchestra-80. There is also an excellent listing of the symbols used in music, their Orchestra-80 equivalents, and the definitions of these symbols. One of the most helpful diagrams (see figure 1) matches the symbols of the Orchestra-80 scale to their places on the standard musical staff.

The manual is repetitive to a certain extent, but that's not a problem; in fact, it helps clarify some points. The organization is a bit awkward. Some of the simpler, more fundamental instructions come after the more complex ones. A basic section on "Interpreting the music language" starts on page 27, while the section "Transcribing Music," which is a summary of the same information, appears on pages 11 through 13. In between these two sections, you are given lessons on how the synthesizer works, how to use Orchcopy, etc. However, it doesn't take long to become familiar with Orchestra-80's peculiarities and to realize the instructions are more than ade-

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PRINTER PORT	YES	YES	YES
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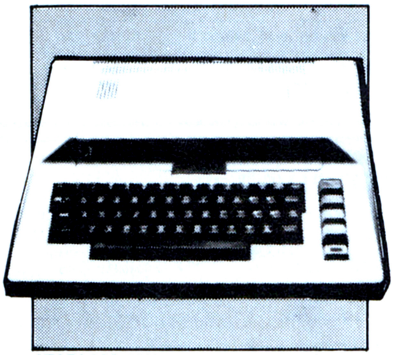

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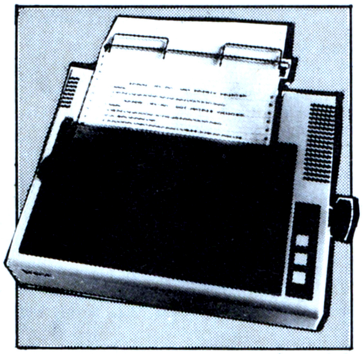

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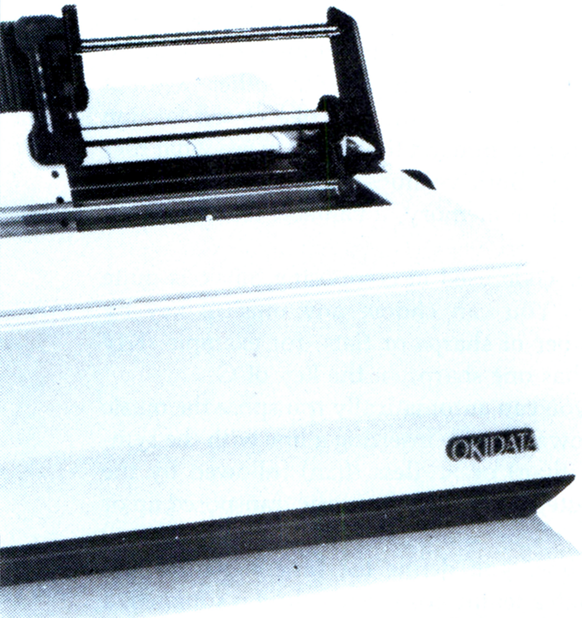

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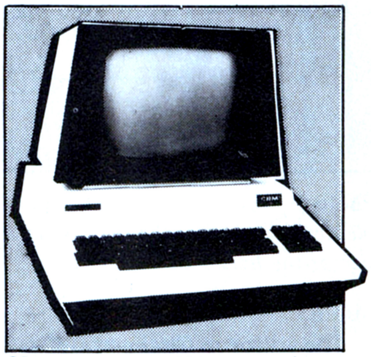

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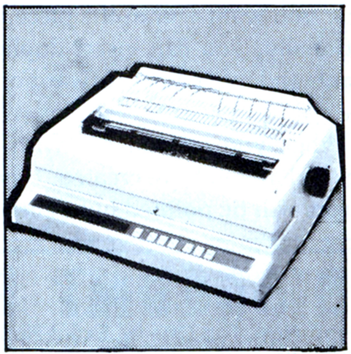

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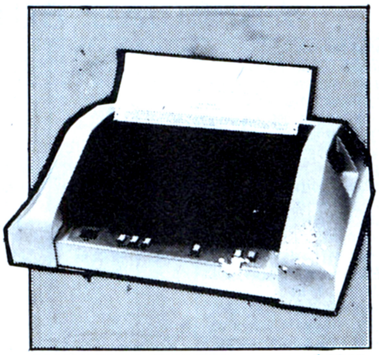

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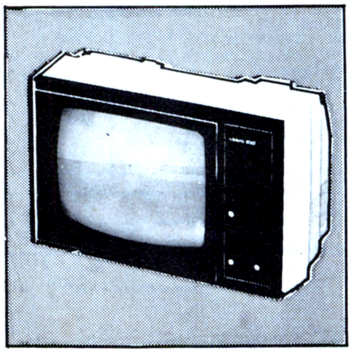

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Orchestra-80
ORCHESTRA-80
Software Affair, Ltd.

Photo 1: *The complete Orchestra-80 system. The system is simple, and is mainly software intensive, as evidenced by the small size of the hardware interface.*

quate.

The editor in Orchestra-80 is easy to use. It uses the arrow keys on the keyboard to position the cursor wherever you want within the piece you are working on. Additionally, you can insert duplicate lines anywhere you want and move lines forward or backward through your file.

When you are finished with a piece, or you want to hear what you have created, type SCORE and any syntax errors will be pointed out. Then type PLAY and listen to what you've typed in.

When you are in the command mode, you can read in previously scored pieces from cassette tape or disk. Pieces can also be "chained" from the storage medium, so several pieces can be played one after the other without intervention from the operator. The disk-based version includes a directory command that lets you see what files are on your disks. Both versions, tape and disk, allow printing of any file in memory, a valuable feature in any program.

The computer code used in composing music is quite straightforward. You can choose any musical key by stating the number of sharps or flats, for example: K1# means the key has one sharp, ie: the key of G.

From there, you can automatically transpose the music to a higher or lower key by inserting a line with the symbol > (greater than) or < (less than) followed by the number of half-steps you wish the music transposed up or down.

On another line, you define the time signature and tempo. (Although a tempo conversion chart is supplied, a limitation of the program is that the tempo must be determined largely by trial and error.)

Next, you define the tone-color registers of up to four voices; in other words, how you want them to sound. A bit of experimentation reveals that if you want the first voice to play with a clear, bright sound and the second voice to have a fuller, more textured sound, you type V1YA V2YD. By defining each of the voices' tones using

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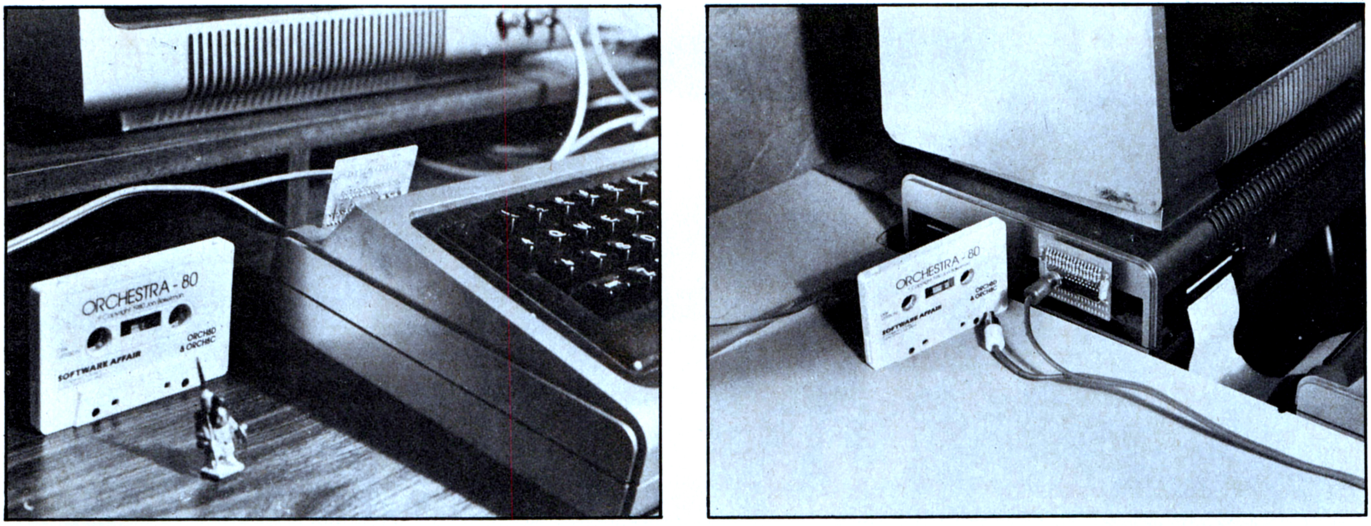

Photo 2: *Orchestra-80 can be connected to either of the expansion connectors available on TRS-80 computer systems.*

A, B, C, or D, in different combinations, you can achieve a variety of effects. When you're ready for the actual notes and rests, you can transcribe anything from whole notes to sixty-fourth notes, dotted notes to triplets, and you can choose whether or not to modify any note with short or long staccato, or short or long articulation. These modifiers determine how sharply a note ends, and give expression to your music. To further alter the mood of a particular phrase or section of music, you can define a new part (P followed by a two-digit number) and change the tempo, tone color, etc, to achieve the desired effect. Repetition of a phrase or an entire part is easily achieved by entering the correct symbols (parenthesis, or R, followed by the number of the part to be repeated).

There is one major limitation to Orchestra-80. It is in the area of dynamics. You can't change the loudness or softness of a phrase—there is no piano, forte, crescendo, or decrescendo. It is possible to compensate somewhat for this by altering the tone-color registers of the voices here and there, but the effect is like that of a modified harpsichord. In fact, the music composed when that instrument was in vogue (the 17th to mid-18th centuries)—the even-tempered, full sound of the baroque period—is particularly suited to interpretation by Orchestra-80, although the program has much wider potential.

Orchestra-80 is an excellent package for the programmer or musician interested in making music with a TRS-80 computer. It requires neither an accomplished programmer nor a professional musician to operate. Its instructions are clear and well written, and the hardware is simple to attach and use.■

Since this review was written, Software Affair has introduced Orchestra-85, featuring stereo output, percussion, new editing features, and an optional fifth voice for use with speed-up modifications; it is compatible with existing Orchestra-80 files. Orchestra-85 costs $129.95. An upgrade for Orchestra-80 systems is also available.

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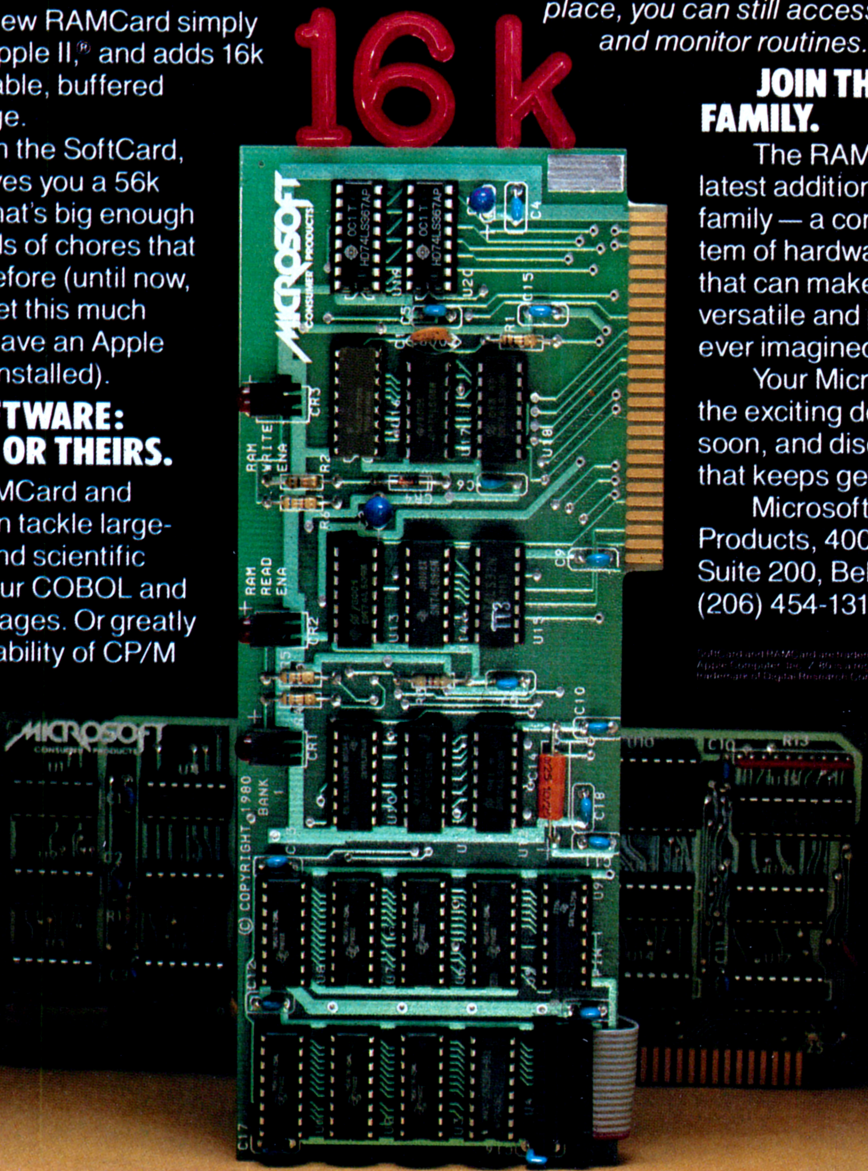

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MICROSOFT

Apple II File-Management Systems

Ken Blochowiak
c/o KRB Associates
POB 11894
Milwaukee WI 53211

> *[Simonides] inferred that people desiring to train this faculty [of memory] must select places and form mental images of the things they wish to remember and store those images in the places, so that the order of the places will preserve the order of the things, and the images of the things will denote the things themselves.*
>
> *Cicero*, De Oratore

Strictly speaking, the terms *data-base management system, data management system*, and *data-base system* refer to programs that meet the CODASYL (Conference On DAta SYstems Languages) standards for data-base systems. MDBS from Micro Data Base Systems is one such example of a system modeled after the CODASYL standards. The systems we'll be examining are traditionally referred to as file-management systems (see reference 5 for a more complete discussion). Because of various practical limits (such as time and space), we will not cover any programs that run under Digital Research's CP/M operating system.

At the highest level of generality we will be looking at the portability, maintainability, and current utility of the following systems: Infotree, the CCA DMS (Data Management System), the Data Factory, the On-Line Database, and High Technology's DBMS (Data-Base Management System) and Information Master (with Data Master). (See textboxes for addresses and ordering information.)

Portability includes the notion of both the independence of the software from the Apple computer and the independence of your data from the software. Maintainability of the software system includes the ability to back up disks and access the source code. Maintainability of your information includes sort-and-file redefinition facilities. Current utility includes initial definition (system creation), data entry, retrieval, and report printing. Although we will be emphasizing effectiveness, we will also cover several efficiency characteristics, such as whether or not data entry is I/O (input/output) intensive, whether or not disk space is wasted, and whether or not searching or sorting is excessively slow.

Your application and your values determine the importance of these various features. To effectively evaluate the systems, you must know yourself. If you use your microcomputer to produce reports according to country and type of equipment for the multinational corporation you work for, your needs may differ from those you would have if you used your system for order entry and inventory information at your local computer store.

Defining the Features

Portability is divided into machine independence and data-file independence. In the face of the vast uncertainty about what equipment will be obsolete, portability frees you from the need to anticipate. Machine independence gives you the ability to

About the Author

Ken Blochowiak edits a newsletter, called Bits of Data, *for the Cybernetic Mechanism. He is president of KRB Associates, which provides information about Decision Support Systems (DSS) and small computers, and vice chairman of the Milwaukee chapter of the Association for Computing Machinery.*

At a Glance

Name
Infotree

Type
Tree-structured information system

Distributor
Siro-tech
6 Main St
Ogdensburg NY 13669
(315) 393-2640

Price
$70

Format
5-inch floppy disk in UCSD format

Language
UCSD Pascal

Documentation
12 pages

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HP-83 $1790.00

HP-83 is the same in capabilities of the HP-85 less the tape storage and printer.

82903A HP+85/83 16K Memory Module $255.00

Firmware Enhancements:			**Interfaces:**	
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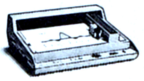
85-15002	Plotter/Print	$135	82939 opt 001 (male)	$339
85-15003	In/Output	$274	Same 002 (crrnt 1p)	$339
85-15004	Matrix	$135	82940A GPIO	$421
85-15005	Adv.Prog.	$274	82941A BCD	$420
85-15007	Assembly	$127.5	82949A Printer Int.	$269



7225
Graphics Plotter
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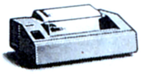
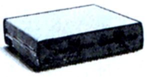


HP 2631B
Matrix Printer
$3295.00



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85-13010	Games	85-13037	Regression Analysis
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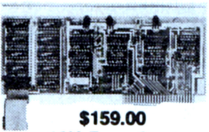
with CP/M



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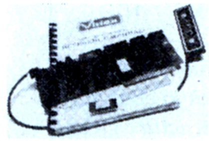

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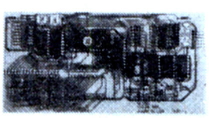

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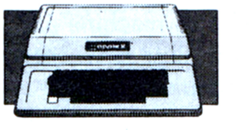
APPLE COMPUTERS



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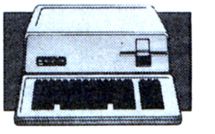

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SSM A488	CALL	TKC Joystick II	$ 45
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DOS Tool Kit	$65		
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Desk Top/Plan II	$165	Visiplot	$147
CCA Data Mgt.	$84	Visidex	$159
		VisiTrend/Visiplot	$229
Microsoft: (requires Z80 SoftCard & CP/M)			
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Peachtree/40: (requires Z-80 SoftCard & 16K RAM Card)			
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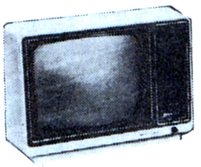

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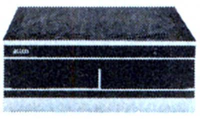

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move from machine to machine and not waste time learning new software. Data-file independence gives you freedom to use your data file with another file-management system. None of the systems described in this article gives true CODASYL data independence, but some give you more flexibility than others. With a text editor, a copy of the structure of your record, a little analysis, and some programming, you can often achieve considerable flexibility, even if at first glance your record structure seems to be set in concrete.

Maintainability consists of backup, access to source code, sort facilities, and redefinition facilities, and it refers to your ability to continue operating your system. If your data files need some slight changes, if your program has a bug, or if your "locked" (uncopyable) disk doesn't work any more, how do you get up and running again? This area is complicated by the spectre of software piracy and the high mortality rate among new businesses.

Current utility refers to initial definition, data entry, data retrieval, report printing, interface to outside packages, human factors, documentation, and something I call "macro-efficiency." No matter how portable and maintainable a system is, if it's not useful there's no point in having it.

Portability

Infotree is the most *machine-independent* system we will examine here. It is distributed in UCSD Pascal (developed at the University of California at San Diego) *p*-code (pseudo-code) and, with the proper utilities, can be transferred to other UCSD systems. The CCA DMS also has slight

	Infotree	CCA DMS	Data Factory	On-Line Database	DBMS	Data Master	Information Master
Source code available	N	Y	N	N	N	N	N
Copyable disk	Y	Y	N	N	Y	N	N
Characters per field	NA	232	239	26	100	NA	99, alpha 19, numeric
Fields per record	NA	24	88	20	20	NA	20
Characters per record	NA	232	21 K	239	2 K	NA	1980
Select by specified range	N	Y	Y	Y	Y	Y	Y
Select by partial match	N	N	Y	N	N	Y	Y
Select using multiple fields	N	N	Y	N	Y	Y	Y
Allows subsorts	Limited	Y	Limited	Y	Y	NA	Y
Prints mailing labels	Y	Y	Y	Y	Y	NA	Y
User-defined print formats	N	Y	Y	Y	Y	NA	Y
Multiline defined print formats	N	Y	Y	N	Y	NA	Y
Add/delete fields to/from file	Y	N	Y	N	N	Y	N
Merge files	N	N	Y	N	N	Y	N
Calculation options	N	Y	Y	N	Y	Y	Y
In-memory data entry	N	N	Y	Y	N	NA	Limited
Data entry default values	N	N	N	Y	N	NA	Y
Interface to VisiCalc	N	Y	N	N	N	N	N

Table 1: *A quick summary of features for Apple II data-base management systems. DBMS and Information Master are both file-management programs used in conjunction with Data Master, a file-restructuring program. Infotree's tree structure gives record sizes slightly different meanings (each node is identified by a key of up to 18 characters in length; each node can contain up to 18 lines of 26 text characters).*

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Nobody's better protection than The Marshal in Winchester territory.

You got yourself a Winchester disk drive with all that large system power. Great! But trying to utilize your floppy drive for backup just isn't working. And bit-streaming tape cartridge drives offers no practical protection, because the usual need is archival storage and replacement of individual files lost through operator error; but the streamer tape data cannot be reconstructed by separate files easily.

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He's the only match in speed, capacity, and capability for your Winchester. As Thomas S. Stellinger, Manager of Marketing Literature with Computer Service Systems Network, Inc. stated in InfoWorld, "Intelligent tape subsystems, combining the 1/4-inch tape cartridges with file-oriented software offers the best solution to hard disk backup...a utility program...allows the user to save every file in the system, as well as to restore individual files by name."

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The TKS Marshal

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potential for machine independence; it is available in source code and could be translated into another dialect of BASIC. The other systems (Data Factory, On-Line Database, and High Technology's DBMS and Information Master) come on locked or unlistable disks and have no machine independence.

At a Glance

Name
The Data Factory 3.0

Type
File management and retrieval system

Distributor
Micro Lab
811 Stonegate
Highland Park IL 60035
(312) 433-7877

Price
$150

Format
Locked 5-inch floppy disk

Language
Applesoft BASIC

Documentation
88 pages

At a Glance

Name
CCA Data Management System 5.2

Type
File management and retrieval system

Distributor
Personal Software
1330 Bordeaux Dr
Sunnyvale CA 94086
(408) 745-7841

Price
$100

Format
5-inch floppy disk

Language
Applesoft BASIC

Documentation
130 pages

Infotree does not include any data-file transfer utilities, but there is a text file on the program disk that details how data is stored. Infotree uses a binary tree and consists of a set of records that can be used for text or as nodes in the tree.

The CCA DMS provides utilities for transferring data between VisiCalc and DMS using Software Arts' DIF (Data-Interchange Format). The documentation provides information on the structure of DMS records and examples of the use of this information (including a program that uses DMS files).

The Data Factory provides a Construct/Append option that enables you to read text files created by other systems into Data Factory files. The Data Factory can also add or delete fields in a record and create new files that include the new format and your old data. Information is not provided on the structure of Data Factory files. This system provides flexible methods of moving data into the system, but no documented way of moving data out to other systems.

The On-Line Database does not provide any transfer utilities or file-structure information.

High Technology's DBMS has no utilities that increase flexibility, but both Data Master and Information Master will accept DBMS files. An option for transferring data from Information Master to DBMS is not provided. Data Master can create new DBMS files from old DBMS files.

Data Master is a package of utilities for use with either DBMS or Information Master. It does not document methods of working with files created by other systems. Data Master includes some nice options for adding or deleting fields in a record and for transferring records that meet user-specified criteria to another data file. There is a Data Master equivalent to the command "Select all records where the *ZIP code* field has the value 22153, and the *Amount Owed* field is greater than $10,000; then, transfer only those records to a new data file leaving out the phone number but including a new field called *Comments* whose value is *big spender*. Data Master does supply an extensive set of file restructuring features that are quite useful.

Maintainability

With the coming of the locked disk, a widespread misnomer has developed an appropriate meaning. I refer to "software maintenance." Infotree and the CCA DMA come on copyable disks, which enables you to keep as many backup disks as you wish. The Data Factory comes on two uncopyable disks. "Disk insurance" is available for $17.50 per year. This provides for replacement of blown disks *and* updates to the system. Data Factory disks can also be renewed for a $10 fee if you don't have disk insurance. A backup copy of the On-Line Database is available for $15. When you return High Technology's license, you are sent a backup copy of Data Master or Information Master. DBMS is copyable but it cannot be listed. High Technology says it will replace blown disks for $25.

Only the CCA DMS provides access to source code. Access to source code is reassuring to a purchaser (but see Gemignani's "Legal Protection for Computer Software" for a discussion of the current legal situation concerning software protection).

Infotree provides a file compression option that removes deleted information and improves access time by sorting and relinking the remaining data. Sorting is also done during data entry. The only subsorts are those built into the tree structure (the subbranches of each branch are sorted).

The CCA DMS allows up to ten levels of subsorts. (Whenever two records have the same primary-sort field, they are arranged by the secondary-sort field, and so on.) The use of source and destination disks allows you to sort large files.

The Data Factory allows what amounts to sorting by subfields for day, month, and year. But that's all. And since this information must be in one field, in an invariant format (dd/mm/yy), you lose considerable flexibility of ad hoc query. Of course, you could do without time subsorts (or enter the data twice). Single- or

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dual-drive sorts of a full-disk data file are possible.

The On-Line Database allows subfield sorts. Data is sorted at time of entry, but with reasonably small sets of defined sorts, data entry is not slowed too much.

The High Technology DBMS also allows subfield sorts, but sorting is separated from data entry. An Omit Sort Update option allows Information Master to postpone sorting until the end of your entry or file-modification session. Sorting can also be completely separated from data entry, but some extra work is involved (deleting and redefining sort-definition files). Technically, Data Master performs no sorting, but is simply a utility program for reorganizing files into different formats.

At a Glance

Name
Data Base Management System (DBMS) 5.2

Type
File management and retrieval system

Distributor
High Technology
POB 14665
8001 Classen Blvd
Oklahoma City OK 73113
(405) 840-9900

Price
$100

Format
5-inch floppy disk

Language
Applesoft BASIC

Documentation
55 pages

At a Glance

Name
Data Master 3.2

Type
File-reorganization utility

Distributor
High Technology
POB 14665
8001 Classen Blvd
Oklahoma City OK 73113
(405) 840-9900

Price
$100

Format
Locked 5-inch floppy disk

Language
Applesoft BASIC

Documentation
36 pages

Infotree allows you to add or delete nodes, one by one, to or from your "infotree"—not a particularly powerful method. The On-Line Database doesn't have any facilities of this sort.

There are no explicitly documented methods of adding or deleting fields from an existing CCA DMS data file. But a small file could be transferred to a VisiCalc program that added or deleted columns and transferred back to DMS (a VisiCalc row is a DMS record and a VisiCalc column is a DMS field). This may seem awkward, but it is possible.

The Data Factory has several file redefinition facilities: Construct/Append is the most useful, but Replace and Math can also be useful. Construct/Append allows you to add or delete fields from your record definition, change field length or field position, or append files that have fields of different lengths or in different positions. Replace lets you enter a constant into a specified field of all or selected records. Math lets you do one arithmetic operation involving two fields and store the result in a third field.

Data Master is a comprehensive file-redefinition system. It requires source and destination files created by DBMS or Information Master. It can relocate fields and transfer selected subsets of a file, and create files that have an increase or decrease in the number of fields per record. It can merge files by multiple transfers to the same source file. You can transfer the results of calculations that use up to ten intermediate variables (like a calculator with memory locations) and, apparently, as many arithmetic operations as you have fields. Record selection can be by inequalities, equalities, or pattern matching (leading or trailing string, floating string, or character in a specified position).

Information Master has no file-redefinition options of its own. Its initial file-definition features are required to create Data Master source files. Information Master allows you to load, edit, and save an existing file definition with a new name. A new file definition can be edited until data is entered into the file it defines. This capability simplifies the process of defining new source files for Data Master if the required file is similar to an existing file.

Current Utility

What will these systems do for you right here, right now? We will be examining features that tell you whether or not you can use these systems to define a data file that meets your needs, enter your data easily, get the reports you want, or exchange data with outside packages. We will see whether or not the systems take human factors into consideration, and will look at the documentation and discuss "macroefficiency."

With Infotree, the initial definition of the information structure (which most of the systems refer to as system creation) is intimately related to data entry. As you enter data you create a tree structure. If this structure fits your application naturally and isn't too redundant, it can be very pleasant to use. If it doesn't fit, or results in redundancy, then it isn't pleasant to use. Each node in the tree is identified by a key. Keys may contain up to eighteen letters. Text may be stored at each node. Text lines are twenty-six characters long and multiple lines can be appended. Each node has only one parent but may have multiple children.

The CCA DMS has a close-to-standard record-definition block that includes information on field number, field ID (identification), field name, and field length. Sorts are defined separately. DMS allows you to define fields in which values are calculated automatically. You can say the DMS equivalent of "add field one to field two and put the result in field three." The length of a DMS record must be less than 233 characters, and a record may contain up to twenty-four fields.

The Data Factory has fairly stan-

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dard file-definition features, although some are implemented strangely. For example, your field name must not be larger than your field. The tradeoff forced by this peculiarity will be discussed later. A field may have up to 239 characters. The number of fields per record must be less than 89.

Initial definition for the On-Line Database is standard. You specify the number of fields in your record, and for each field you specify its name and length. You can have up to twenty fields per record, twenty-six characters per field, 239 characters per record, nine sort keys per file, and unlimited subsorts per sort (three is recommended as a practical limit).

At a Glance

Name
On-Line Database

Type
File management and retrieval system

Distributor
Blue Lakes Computing
3240 University Ave
Madison WI 53705
(608) 233-6502

Price
$100

Format
Locked 5-inch floppy disk

Language
Applesoft BASIC

Documentation
21 pages

At a Glance

Name
Information Master 3.10

Type
File management and retrieval system

Distributor
High Technology
POB 14665
8001 Classen Blvd
Oklahoma City OK 73113
(405) 840-9900

Price
$150

Format
Locked 5-inch floppy disk

Language
Applesoft BASIC

Documentation
145 pages

DBMS gives you simple, direct file-definition features. You can define sorts during or after your initial definitions, and subsorts are allowed. You can have up to twenty fields per record, and 100 characters per field.

Information Master provides extensive system-creation options. You can have up to twenty fields per record, 99 characters per alphanumeric field, nineteen characters per numeric field, five sort keys per file, and five subsorts per sort. Up to 1000 records are allowed per file, but not as many long records will fit on a disk: the number of records is limited to what will fit on one disk.

Data entry for Infotree is disk-I/O intensive (as it is for all systems that don't let you accumulate data in memory). You spend a lot of time waiting for it to write information to disk. Worse, if you need the same information in two separate branches of your tree, you must enter this information twice. Data-entry commands are simple and direct (although they could be better documented).

The CCA DMS does not allow you the option of inspecting and correcting a record after you have finished entering it and before it is saved. If you wish to make corrections, you must use individual search, and update or delete commands. CCA DMS uses the standard prompt: it lists the field names before you enter your data. DMS does not have in-memory data entry.

The Data Factory has good and bad data-entry features. It does have in-memory data entry, but it forces you to choose between cryptic prompts or efficient use of disk. (This is discussed in more detail under macroefficiency.) You *can* verify your entry before moving to the next record.

The On-Line Database has the best data-entry features of any of the systems I have examined. You can define default entries, and do in-memory data entry and avoid waiting for the completion of needless disk I/O. Incorrect entries may be easily corrected by directing the cursor to the spot and reentering the data.

DBMS allows field correction at the end of the entry of a record—it also does error checking. However, it does not allow in-memory data entry or default values. Information Master does not have user-controlled in-memory data entry. Sometimes it accepts more than one record on its own initiative. Sometimes (rarely) it will miss characters because an internal Applesoft operation takes place. It allows you to correct records before saving them to disk, and it beeps after writing to disk. (The previous entry to any field is the default value of the current field.)

The benefit of systems like these comes from the reports they produce. We will examine the way these systems select a record to report, format the report, and calculate any derived results.

Infotree's retrieval commands retrieve either information about the tree structure or information that you have stored at the various nodes. The commands are easy to learn (even though the documentation is a bit sparse), but they are not very powerful. If you do not anticipate the requests you need to make of Infotree and build them into your tree structure, you will not be able to ask them, much less get an answer. If your tree structure goes directly from the "information retrieval systems" node to the specific program nodes without passing through a "for the Apple" node, you will not be able to ask Infotree "what information retrieval systems run on the Apple?"—not even if that information is somewhere further up the tree.

Several record-selection options are scattered through the CCA Data Management System. You can select records that have a particular record number, records that have a particular value in a particular field ("Display all records that have a value of *information system* in the *type of software* field"), and records for

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which the value of a particular field lies within a certain range ("Display all records for which the value of the *cost* field is between $50 and $400"). You cannot, however, do selections that require testing the values of multiple fields ("Display all records where the value of the *host machine* field is *Apple* and the value of the *allows multiple selection criteria* field is *yes*"). The system does select on partial matches. DMS has a somewhat limited set of features that are quite cumbersome to use.

The Data Factory includes several methods of selecting records that are not, however, grouped together. List, Search, Level Search, From/To, Compare, and Inspect/Change are separate main-menu options. The Level Search option allows multiple-criteria searching and searching for partial matches. You can specify record numbers if you wish. A comprehensive set of features is provided, but using them is more difficult than need be.

The On-Line Database does not allow selection by multiple criteria on multiple fields. You can specify a range that the value of a particular field must satisfy in order to select the record ("Select all records for which the *last name* field has a value of *Dijkstra* or greater and *Wirth* or less"). You cannot search for partial matches.

DBMS allows multiple selection criteria on multiple fields. Inequalities are allowed, but not partial matches. Since subsorts are allowed, I consider these features to be reasonably complete. They are certainly very easy to use.

Data Master has sophisticated selection features, but they are used to restructure files. They are not used directly for report purposes. Up to seven selection criteria may be entered. Multiple fields may be tested. You can test for equality, inequality, or pattern match (leading, trailing, floating, or in a particular position).

Information Master provides the same selection features as Data Master. The only difference is that they are used for reports rather than restructuring. They even use the same notation and menu format. Both systems are comprehensive and usable.

Infotree allows you to print mailing labels, text you've stored at a node, or the structure of your tree. You don't have the power to create your own formats, so the program is limited in this area.

The CCA DMS gives good control over the format of your reports. You can create single- or multiple-line formats. Field position is variable in each line. You can save and reuse the formats you've created and use DMS to print mailing labels. Pages can be titled. Formatting features seem reasonably complete, and they're less cumbersome to use than other DMS features.

In-memory data entry speeds up file-management systems by reducing continuous disk-intensive I/O.

The Data Factory allows multiline formats, but gives no spacing option. You can specify the number of fields per line, title your report, print mailing labels, and save formats, but these features are somewhat limited.

The On-Line Database has a mailing-label format, but otherwise does not allow multiline formats. You can specify field position in its single-line format and save these formats. Its features are limited.

Information Master allows you to create up to fifteen report formats per data file. You have up to 15 columns per line. Each column can have a heading, and you can specify that decimal points be aligned. You can also specify totals, subtotals, and algebraic calculations, insert short labels (such as "total," "subtotal," etc), and define multiline formats and print mailing labels. A nice set of features.

DBMS has a mailing-label format and allows multiline printed reports. You can specify which columns your fields are to occupy, insert unchanging characters into your report formats ("literal strings"), and save formats. It's complete and easy to use.

Infotree does not provide any calculation options. Neither does the On-Line Database. The DBMS provides totaling.

The CCA DMS allows you to create calculated fields at the time you define your data file. Available functions are addition, subtraction, multiplication, division, and exponentiation. The total number of characters used in your formulas must be less than 228. Within this limit, you can create as many formulas as you wish and specify which fields should be used to store the results.

The Data Factory provides a calculation option called Math. You can add, subtract, multiply, or divide two fields, and store the result in a third field. You can also receive a report on the total, average, or count (number of records) of a specified field. You can enter selection criteria and use these functions at any time.

Data Master allows you to add, subtract, multiply, or divide one field by another field, or use intermediate variables that you define. The intermediate variables are like memory locations on a calculator. You can use up to ten intermediate variables. Multiple-step calculations are allowed.

Information Master allows the same operations as Data Master, as well as exponentiation and roots. Multiple-step calculations are allowed.

DML (Data-Manipulation Language), as provided by CODASYL data-management systems, lets you read and write information into your data base from outside programs (among other things). None of the systems we're examining gives you a data-manipulation language, but some give you a little help. I get a headache when I think about all the incompatible files I'm collecting and want all the help I can get (see Martin's *Principles of Data-Base Management* for more about data-manipulation languages). Software Arts' DIF (Data-Interchange Format) is used to transfer information to and from VisiCalc and the CCA DMS. If DIF is widely used we might get some relief from incompatability headaches.

Only the CCA DMS provides a di-

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rect interface to VisiCalc. Perhaps I should qualify that by saying VisiCalc "programs" often require some editing before interchange (unless you like empty fields and literals interspersed in your data). Since VisiCalc provides only primitive filing options and limited information storage in main memory, I expect that many file-management systems for the Apple II computer will eventually supply a direct interface.

Infotree provides a text file that contains information about how to interface your own software to the Infotree data files. Neither the Data Factory nor the On-Line Database provides such information. DBMS has new documentation (which I haven't seen). The old documentation didn't provide any interface information. Both the CCA Data Management System and Information Master provide useful information. DMS and Information Master give you the layout of their files and describe the purpose of each field. The CCA package even includes sample programs.

Commands are simple and direct with Infotree. A help command prints out a list of possible commands with a brief explanation of each command. The command notation is consistent. Infotree is pleasant to run.

There is considerable room for improvement in this area for the CCA DMS. Commands are complex and the formats are not consistent. *You* must remember the correct places to put commas, exclamation points, apostrophes, and various cryptic codes. (Two good discussions of human factors are Shneiderman, 1980 and Snodgrass, 1980.)

The Data Factory has the largest main menu of any of the seven packages. Many of the main-menu options are slight variations of each other and could easily be grouped together as suboptions of a single main-menu item. This would improve the clarity of the system. The Data Factory asks you whether or not you have a printer each time you boot the system or shift from one data file to another. These are not the characteristics of a considerate system. On the other hand, it does have in-memory data entry (and that shows some consideration for human factors). The Data Factory is a little harder to use than need be.

The On-Line Database is the most understanding in term of human factors. It is menu driven, simple, and direct, and the data-entry features are outstanding. The menus are easy to understand, and because the system searches for the next record as you view the current one, your waiting time is greatly reduced. Very pleasant to use.

DBMS has a few weaknesses (one being an excessively long main menu that distinguishes between "search the data base," "print the data base in user's format," and "print the data with mailing list format"). But, all things considered, it's reasonably well engineered and the menu format is generally uniform throughout the system.

Information Master and Data Master have good consideration for human factors. Menus are not excessively long and commands are grouped logically. Their command structure is less uniform than that of DBMS, but otherwise seems well designed. High Technology made an intelligent decision in using the same command format for both Information Master and Data Master (the two programs were designed for each other). They could have achieved more uniformity within that command format (either letters or numbers for specifying menu options, but not both; a single format for menus, etc), but their consideration for human factors is generally good.

Documentation serves different purposes at different times. The kind of documentation that is best when you're first learning a system is *not* the best when you've had some experience. The writer must include a tutorial, reference material, and consider who the reader is (a novice? A grandmaster? someone in between?).

Infotree's documentation is sparse, but because its user interface is well designed, this is acceptable. A text file on the program disk explains

Text continued on page 292

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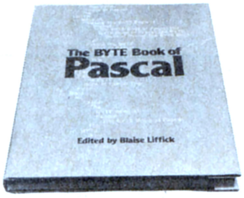

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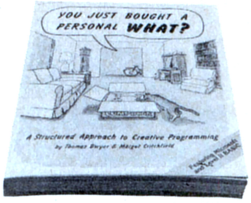
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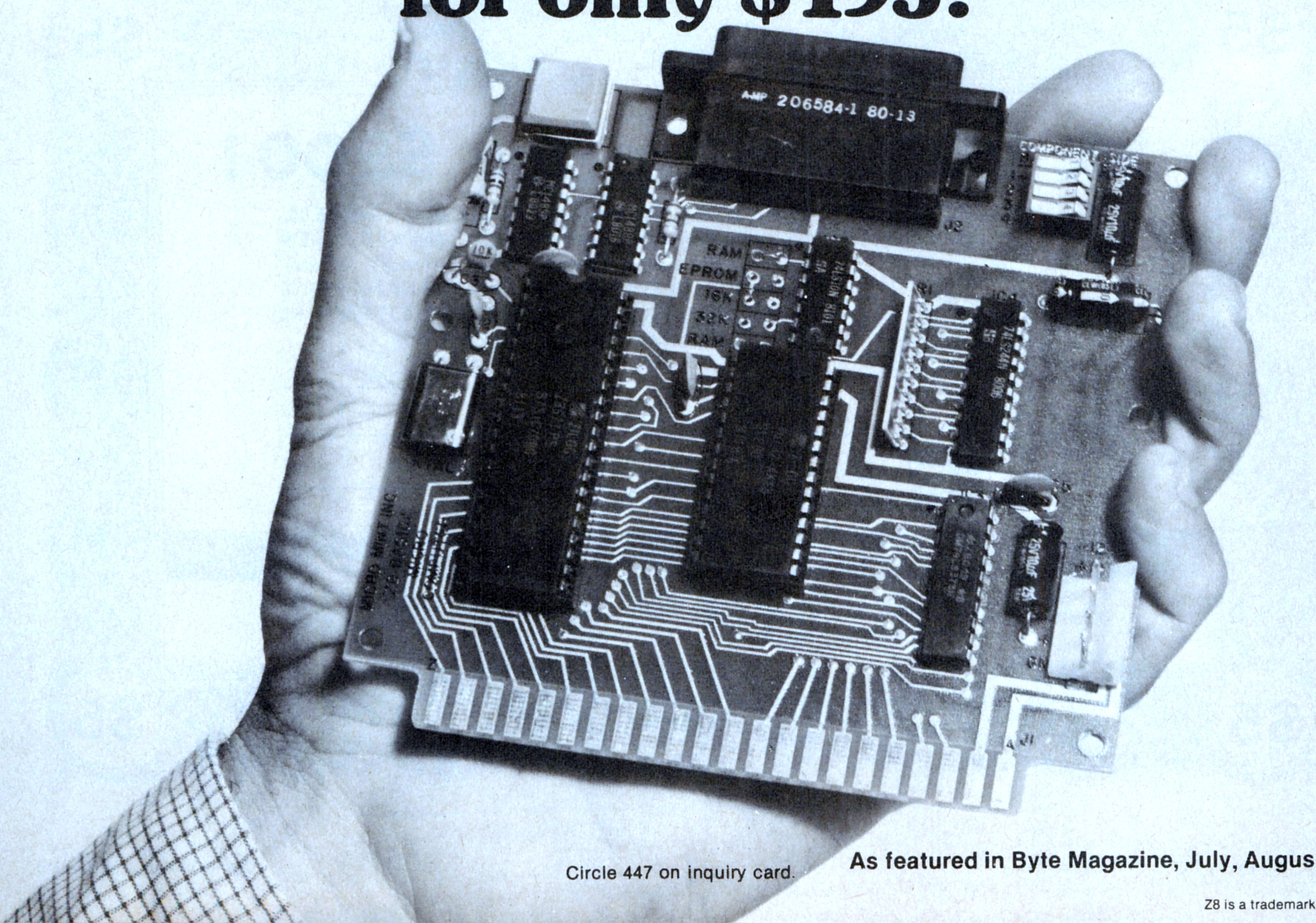

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As featured in Byte Magazine, July, August, 1981.

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Text continued from page 286:

Infotree's file structure. There is a table of contents, but no index. A handful of examples would improve things: Infotree's documentation is tutorial.

The documentation for the CCA Data Management System is clear and quite complete. In addition to all DMS functions (including the transfer of information between DMS and VisiCalc) there is, as previously noted, information on the format of DMS files and how to work with them from your own programs. The documentation includes a table of contents and an index. The documentation is both tutorial and for reference.

The Data Factory has reasonably complete documentation, but unfortunately it is sometimes unclear and most things are only explained once. The structure of the manual follows the structure of the main menu. For the most part, the manual works, but a little more detail (or an example or two) would make things clearer. There is a table of contents, but no index. Acceptable for both initial learning and subsequent reference.

The documentation for the On-Line Database is very clear. It includes a procedure for designing an application using the system and a backup procedure that uses disk rotation (similar to rotating your car's tires). Unfortunately, no descriptions of file structure have been included. There is a table of contents, but no index. It is mainly tutorial, but has some reference uses.

Quite recently, High Technology introduced new documentation for DBMS. The previous documentation was sparse and I haven't seen the new documentation. But since it is reported to be fairly extensive (55 pages), and written by the same person who wrote the documentation for Information Master and Data Master (see the next paragraph), I expect it to be generally good.

The documentation for Data Master is generally good, as is Information Master's documentation. Both manuals have essentially identical virtues. Chapter sections are divided into synopses and tutorial subsections, and examples are numerous and detailed. The manuals go beyond describing the options and what they do; for example, under "Efficient methods for entering data," the Information Master manual describes which options work best for entering large amounts of data that don't need to be accessed prior to completion, and which options work best when data comes in little by little and the data file needs to be accessed in-between. Each manual has a table of contents, a quick reference chart, and an index. They are useful for initial learning and for reference.

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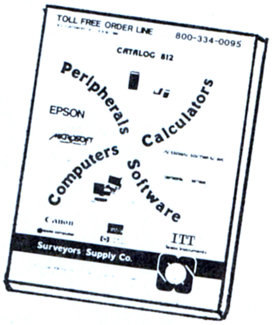

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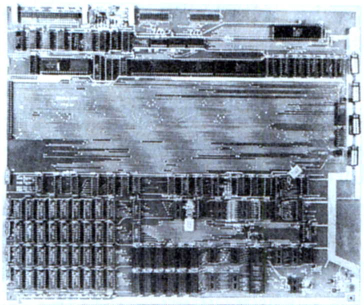

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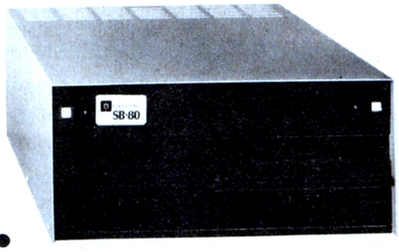

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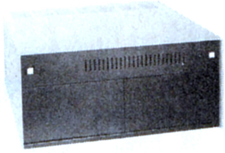

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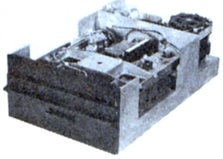

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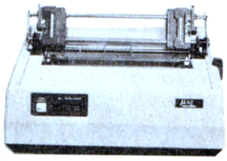

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more extensive discussion of this issue, see Ledgard's *BASIC With Style*.

Only the Data Factory and the On-Line Database have practical in-memory data entry. All the other systems spend a lot of time writing to the disk. Because it regularly requires redundant data entry (if the same information is required by two branches of its tree) Infotree can be even more "inefficient."

All the systems, except the Data Factory, make reasonably efficient use of disk space. Most systems allow you to give your fields a name that is longer than the data field itself. But if you wish to entitle a field "The Number Of Years You've Owned This System," the Data Factory requires you to reserve enough space in your record to hold the entire title. This means that you are regularly forced to choose between cryptic data-entry prompts and fairly large amounts of wasted disk. If you wish to sort your file in more than one order, there is more bad news. The Data Factory requires you to maintain a complete copy of your data file for each sort. Five sorts, five complete copies.

The Data Factory's version of multicriteria selection requires multiple readings of the data file. This is inefficient. By contrast, the On-Line Database searches for the next record that meets your selection criteria while you view the current one. If the time you spend viewing the current record exceeds the search time, your next record seems to arrive the instant you request it.

If you can choose when to sort, sorting speed becomes less important. Both Infotree and the On-Line Database require you to sort during data entry. You have no discretion (Infotree also has a discretionary sort that performs slightly different functions). All the other systems allow you to choose when to sort. If you use a fairly small number of subsorts, On-Line Database and Infotree perform all right. The sorting efficiency of these

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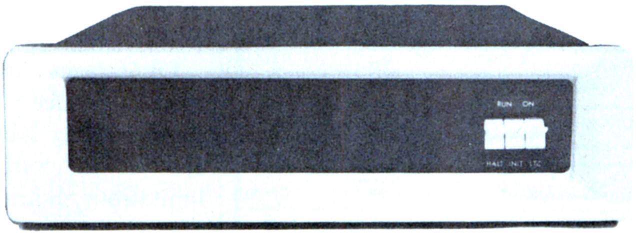

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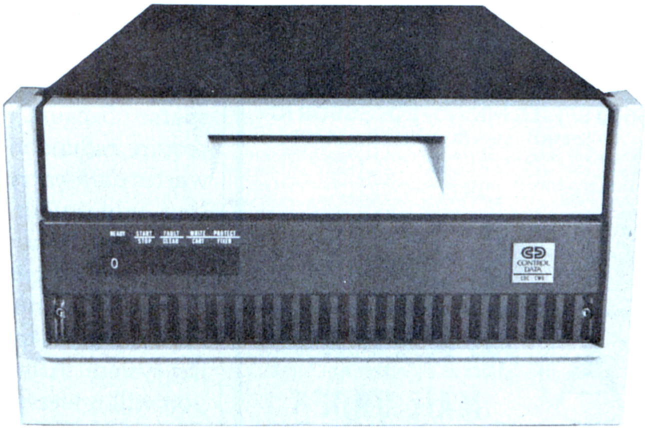

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3.2768	HC33	CY3B	6.00	6.00	HC18	CY6B	6.00	20.00	HC18	CY22A	5.25
3.579	HC33	CY3D	6.00	6.144	HC18	CY6C	6.00	23.684	HC18	CY23B	5.25
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systems should be sufficient unless your machine is busy more than 50 percent of the time.

The On-Line Database has achieved a significant "macroefficiency" by having the whole program reside in main memory. This eliminates the time the other packages spend swapping modules from disk.

Infotree

Now we will look at our alternatives one by one: what collection of features each system has and how pleasant they are to use. Since Infotree is in UCSD *p*-code, it is fairly machine independent. Lack of file-redefinition features means your data is not so independent. Infotree is copyable, but again, you do not get source code. File maintenance is by individual insertions and deletions. The provided sort utility maintains efficiency of access to the data file. That gives you fair maintainability.

Limitations in Infotree's query method reduce its usefulness. It will print mailing labels, but its formats are set in concrete. Within these limitations, human factors are good. System creation is a part of data entry, and no calculation options are included. Information on interacting with outside packages is provided in a text file on disk, but documentation is sparse. Because tree structures often require redundant branches, Infotree wastes data-entry time and disk space (but only if your application requires redundant branches). There's no in-memory data entry.

For all its limitations, Infotree is an interesting package and a good teaching system. After using it for a while, you will understand tree structures in a very direct way. It has good regard for human factors.

CCA Data-Management System

Since the CCA DMS runs on other systems (in other dialects of BASIC) and since you have access to its source code, you have some machine independence. Because you are given information on the format of its files and because there is a way to use the VisiCalc-to-DMS transfer facilities to restructure your files, you have some freedom.

You can make backup copies of DMS and you can examine its source code. It allows subsorts and full-disk data files. You can define calculated fields when you define your data file. You cannot do multiple-criteria selection on multiple fields. Format control is good (multiple-line formats, mailing labels, saving formats, etc). The CCA DMS is the only system that has an interface to VisiCalc. It provides examples of usage of DMS files by outside programs. Its regard for human factors is poor. Documentation is clear and complete (you'll need it). Other than its lack of in-memory data entry, the efficiency of DMS is acceptable. If the system you get must work with VisiCalc, this is the one.

The Data Factory

Since the Data Factory comes on a locked disk, you have no machine independence. You do get enough file-restructuring options to have some freedom from your initial record structure. Moving data from an arbitrary record structure into the Data Factory is quite simple. You get two uncopyable disks and several options for replacing bad disks. Sort and file redefinition options are sufficient to maintain your data file.

The Data Factory gives you good flexibility of file definition. If your application requires a few large records (up to 88 fields per record and 239 characters per field) the Data Factory will accommodate you. You get in-memory data entry. Selection options are comprehensive (multiple selection on multiple fields is permitted). Calculation options are good. Formatting options permit multiple-line formats. No interface to outside packages of your own software is supplied. Regard for human factors could be better. The menus are too long (that's confusing); several times, tedious sequences of questions are used when a menu would work better; each time you change data files you are asked whether you have one drive or two, etc. It does not provide subsorts, except for the date-field subsort. It *will* let you choose when to sort. The Data Factory gives

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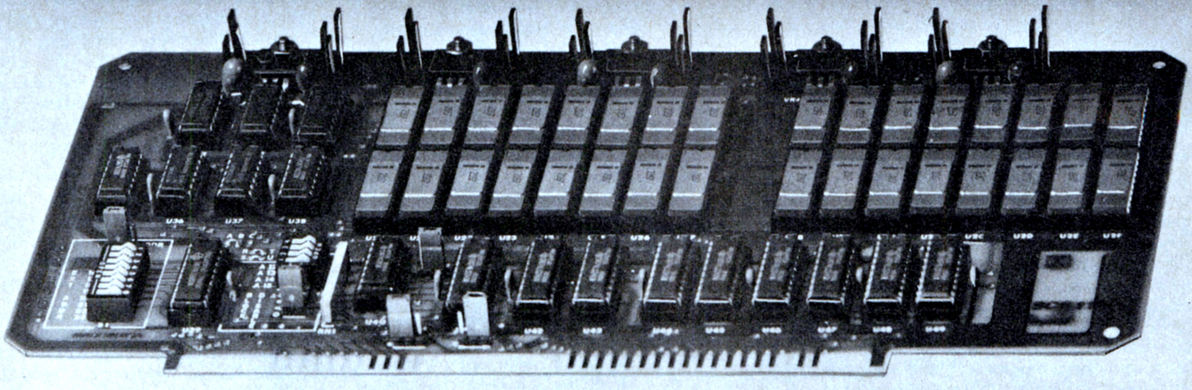

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you a fairly comprehensive set of features at a reasonable price, but it is harder to use than need be.

The On-Line Database

The On-Line Database comes on a locked disk. It does not provide any utilities or information that would help you transfer information from system to system. A backup disk can be purchased for $15. There are no file-redefinition facilities.

Initial definition is easy and subsorts are allowed. The limit of twenty-six characters per field and 239 characters per record might be too confining for some applications. The data-entry options for the On-Line Database are excellent. Default entries, cursor-oriented editing of entries, in-memory data entry, and other options provide outstanding features. No calculation options are provided. Mailing labels and user-defined single-line formats are the only formatting options. Multiple-criteria selection on multiple fields is not allowed, but subsorted keys are available. No interface to outside software is supplied. Documentation has some nice touches (the applications-creation procedure, for example). Sorting is tied to data entry. The entire program resides in memory, eliminating the swapping of modules. While you examine one record, it is searching for the next one. The On-Line Database is well suited to applications requiring fast response. Regard for human factors is *consistently good*. A pleasant system to use.

The High Technology DBMS

DBMS comes on a copyable disk. It has no data-file independence features of its own, but Data Master and Information Master will accept its files. You cannot catalog or list it, but it is copyable. In combination with Data Master, DBMS has extensive file-maintenance features. (Alone it has none.)

The system has standard initial-definition features. It provides subsorts. In-memory data entry is not provided. It can select records for reports using multiple criteria on multiple fields. It allows multiple-line report formats and mailing labels. It will calculate the total and the average of a field, and you can decide when to do your sorts. The only outside software packages DBMS is designed to work with are Data Master and Information Master. Menus have too many options (extra options should be in submenus), but menu format is uniform throughout the system. Fairly good regard for human factors. There is new documentation.

Data Master

Data Master is designed to be used with DBMS or Information Master and comes on an uncopyable disk. There are extensive file-reorganization options. You can merge files (with a series of transfers to a single destination file), you can add or de-

PLAIN TALK ABOUT "COPY PROTECTION"

A lot has been said and written about copy protection and software piracy since Omega made Locksmith available to Apple II users earlier this year. We have been accused of encouraging illegal copying of copyrighted software. Software publishers have threatened to boycott magazines which carry our advertising, and the pros and cons of Locksmith and copy protection devices have been debated in Apple forums throughout the country. But, we at Omega haven't really told you, the Apple user, our side of the story.

Locksmith was originally developed as an intellectual exercise by an Apple user over a year ago. And we suspect that sufficient information about the Apple DOS and the way information is stored on a disk has been long available to the general public, so that ANYONE who was REALLY interested, and who wished to spend a LOT of time, could have written a program that does many of the things that Locksmith does. Similarly, there is really no "secret" to writing data base programs, adventure programs, or even spread sheet programs. The literature is there if you want to look for it. But it takes a lot of hard work to develop any software package that works in all cases, that is crashproof, that interfaces easily with a non-experienced computer user, and that is well documented. A LOT of hard work.

But even before Locksmith was available to us, we, as Apple users, recognized a definite problem with the software we were buying and using. Much of it worked well. But it was very aggravating to not be able to make a backup copy of certain "copy protected" programs. Most software pubishers didn't supply backups of their programs, and those that had any policy required signing opressive agreements or paying questionably high yearly fees for presumed, but not guaranteed, updates. Among those who did not offer back-up was one who 'sold' us a new copy (when we returned our crashed disk). Although they advertised the importance of having their program running every day, they made us wait up to 6 weeks to get the replacement. Most vendors just ignored the problem. We, as consumers, were simply taken advantage of. In many cases we relied so much on a particular program, that it became very costly to have to wait weeks or more to replace a blown disk. Software publishers were just not responsive to the users problems caused by "copy protection".

When we first became aware of Locksmith, we investigated the state of the law, and discovered that no one knew whether the owner of a program could copy it for backup. And for quite a while we debated whether we should market Locksmith.

On December 12, 1980, a change was made to the Copyright Act which resolved these questions. It is now the law of the United States that the existence of a copyright notice on a computer program does NOT make it illegal for the legitimate owner of that program to copy it for archival purposes. Backups are now clearly legal. (Of course, when you sell your purchased program, you must destroy the backups you have made). Only after such use clearly became legal did we decide to sell Locksmith.

Now with the new copyright law, which for the first time gave software publishers clear rights that were enforceable in court, but which also gave "backup" rights to software purchasers, and with the demonstration that Locksmith could and would provide back-up for the user, we assumed that software publishers would drop their copy protection schemes and educate the public as to their rights and responsibilities. Even the use of hardware protection that gives copy-ability to the software would be acceptable. Unfortunately, their response has been to pressure magazine publishers into refusing our advertising, and to invent new copy protection schemes.

Well, the word about Locksmith was impossible to stop. We couldn't advertise, but we have sold a gratifyingly large number of programs. As to new copy protection schemes, the new Locksmith (version 4.0) will adjust to them, and copy virtually anything protected that way. But please. For us, for yourselves, and for the entire industry, use Locksmith only for its intended legal purposes.

The new version is more than just the best copy program available. There are also four additional utilities included. A disk speed program, a degauasser, a nibble editor and a media surface analyzer are included. And we stand behind our products. Our customer service department is available (and anxious) to help with problems.

Locksmith 4.0 is available from us, or your local dealer. Visa and Mastercard users call Toll Free 1-800-835-2246. Kansas residents call 1-800-362-2421 or send $99.95. (Registered owners of prior versions can obtain an update for only $20. If you haven't received a letter from us, please call.)

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Data Master requires a source and destination file defined by DBMS or Information Master. It cannot create its own record definition. Both its documentation (extensive) and its regard for human factors are generally good. Use with outside software is possible but not documented; efficiency is adequate. Data Master is an extremely useful addition to DBMS or Information Master.

Information Master

Information Master comes on an uncopyable disk. As mentioned above, Data Master provides it with considerable redefinition capabilities.

In addition to the standard file-definition options, Information Master can edit existing file definitions (useful if a new application shares some characteristics with an existing one). Your previous entry is the default value of your current entry. Extensive selection and calculation options are available (inequalities, leading strings, trailing strings, floating strings, characters in particular positions). Multiple-criteria selection on multiple fields is permitted. The file information eases the interface of outside software to Information Master. Regard for human factors is generally good (Data Master and Information Master have the same command format). Efficiency is adequate. A very practical system (particularly in combination with Data Master).

Conclusions

- The worst system we could construct using the features these systems provide would have the poor consideration for human factors of the CCA Data Management System, the inflexible tree structure and limited query options of Infotree, the huge menus and inefficient use of disk space of the Data Factory, the limited record size and lack of field redefinition options of the On-Line Database, the nonuniform menu formats of Data Master/Information Master, and the numeric error codes of DBMS. It would come with sparse documentation on a locked disk.
- Even if the traditional distinction between the words "file-management system" and "data-base system" is lost, be aware of the difference between systems that meet the CODASYL data-base standards and those that don't.
- Software Arts' DIF holds out the possibility of relief from data-file-incompatibility headaches.
- The best system we could create using the features these systems provide would have the basic characteristics of the very practical Information Master/Data Master combination; the data entry features, quick response, and general pleasantness of the On-Line Database; the interface to VisiCalc and good documentation of the CCA DMS; the educational value and good regard for human factors of Infotree; the uniformity of command format of DBMS; and the cost per feature of the Data Factory. It would, of course, come in source code on an unlocked disk. ■

References

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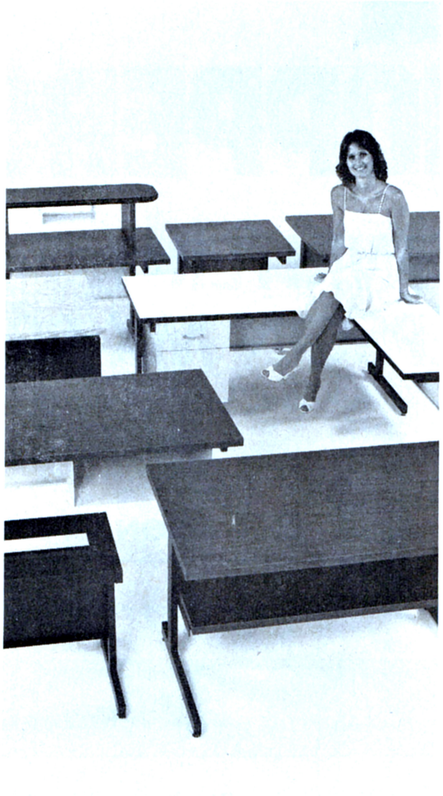

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BYTELINES

News and Speculation About Personal Computing

Conducted by Sol Libes

IEEE S-100 Standard Is On The Way: The IEEE-696 Standard for the S-100 microcomputer bus has been completed by the working group and submitted to the IEEE (Institute of Electrical and Electronics Engineers) Computer Standards Committee for adoption. Formal acceptance is expected by early 1982.

The S-100 bus has been changed radically from its original implementation in 1975 by MITS, who employed the bus in the Altair 8080 microcomputer. New features include 8- or 16-bit-wide data path (to accommodate the new 16-bit microprocessors), direct-memory addressing of up to 16 megabytes (previously 64 K bytes), direct I/O (input/output) addressing for as many as 65,536 ports (previously 256 ports), a new protocol that can handle 16 masters on one bus, timing specifications for 6 MHz clock operation (some manufacturers envision operating at over 10 MHz), and an expanded interrupt system of up to 11 lines (previously 7).

The standard will dispense with pin assignment and timing conflicts that plagued S-100 users because of variations between manufacturers. It also allows for future expansion of the bus to support changes in the state of the art (e.g., 32-bit microprocessors).

The importance of the standard is that there are almost 40 manufacturers of S-100 systems and about 50 others making hundreds of S-100-compatible products. There is no doubt the IEEE 696/S-100 is presently the most powerful microcomputer bus in wide use.

If you would like a copy of the proposed IEEE-696 Standard, write to Sol Libes, IEEE-696 Committee Secretary, POB 1192, Mountainside NJ 07092. Please note that each copy costs $6 in the US and $8 elsewhere (US funds only).

Japanese Find Moving Into US Computer Market Hard: The Japanese are starting to move into the US small-business-computer market in force, but they're finding it more difficult than expected. The Japanese appear prepared for a long-term commitment: most are setting up dealer organizations and developing software packages for their hardware. However, it is becoming evident to the Japanese that their hardware is suited to the American market but their software is not. Because of this, it is likely that their penetration will take two to three years to become significant.

Although NEC (Nippon Electric Corporation) has been selling systems in Japan for more than two years, it has met resistance from American dealers because of a lack of software applicable to the US market. NEC is recruiting software suppliers to overcome this problem.

Mitsubishi introduced its small-business computer in the US in 1979 and boasted that within three years it would have 10% of the market. Now Mitsubishi realizes that the US market is hard to crack. It, too, has met with considerable resistance from dealers and is attempting to have several software packages developed.

Toshiba has taken another tack by opening two computer stores in the Los Angeles area. The stores carry Toshiba's entire line of office products, including its desk-top computer.

Sony appears to be having problems delivering its Series 35 word processor, which was introduced at the beginning of the year. Also, it only just started shipping samples of the new 3½-inch disk drive to OEMs (original-equipment manufacturers). Rumors abound about a Sony personal computer, but none has yet surfaced either in the US or Japan.

Canon has decided to play the role of an OEM, thus passing its CX1 desk-top system's software problems on to distributors. (The CX1 is based on Motorola's 6809 microprocessor.) Canon has disclosed an agreement with a software supplier for seven accounting packages.

Sharp has introduced the YX-3200 small-business system to the US market. It had been sold previously in Japan. For the US version, Sharp has decided to go with Digital Research's CP/M operating system and the software packages currently available to operate under it. Sharp plans to sell the YX-3200 through systems houses, office-machine dealers, and office-supply houses.

Half-Size 5-Inch Floppy Drives Coming: At least three floppy-disk makers will soon introduce 5-inch floppy-disk drives that are only $2\frac{1}{10}$ inches tall (half the height of a standard floppy disk). It will be possible to fit two drives in the space previously occupied by one.

The first "slimline" drive is expected to be introduced by Alps Electric Inc (a Japanese concern). It's actually less than half-size, being only $1\frac{1}{16}$ inches high. It will be available in 125 K- and 250 K-byte versions. Remex, Irvine, California, is expected to have its $2\frac{1}{10}$-inch-tall drive out by year's end. The Oyx division of Exxon is making a half-size drive that's already being used in a smart typewriter.

Microprocessor Makers To Add Floating Point: Intel, Motorola, and Zilog will soon be adding floating-point functions (FPFs) to their 16-bit microprocessors. All three will use separate integrated circuits functioning as coprocessors. Intel is already providing samples of its iAPX 86-20, which contains both the 16-bit 8086 microprocessor and the 8087 numeric processor; production is expected to begin early next year.

Motorola plans a coprocessor for its 16-bit 68000 microprocessor but, in the meantime, will supply an FPF firmware package that allows 32-bit multiplication and division. Both Intel and Motorola will conform to the proposed IEEE (Institute of Electrical and Electronics Engineers) FPF Standard. Zilog is rumored working on an FPF device for the Z8000. It should be announced by year's end.

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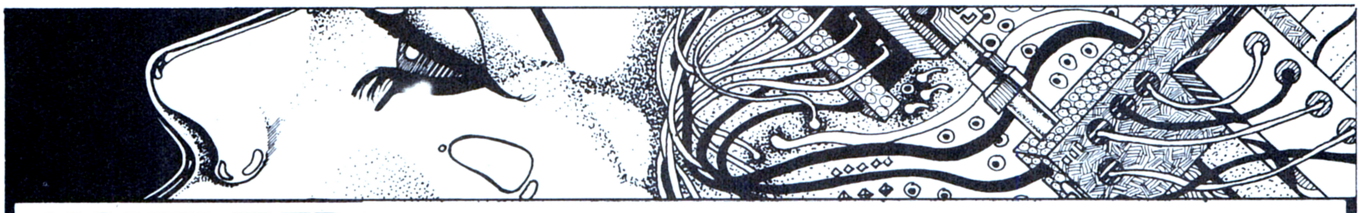

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Japanese Robotics Industry On The Upswing: The Japanese government is subsidizing its nation's robot makers in the same way that the computer industry was backed ten years ago. In April 1980, the Japan Robot Leasing Company was launched. After one year of operation, it is already renting $5.5 million worth of robots and expects to raise this to $12.5 million by the end of next year.

Japanese robot production last year totaled $375 million and is projected to rise to $1 billion by 1985. Last year, only 3% of robotic production was exported. One problem with these figures, however, is that they include human-operator manipulative and pick-and-place machines.

About 40% of the robots are used in the automobile industry, about 20% in electrical machinery manufacturing, and about 10% in plastics molding. There are an estimated 130 robot manufacturers in Japan.

Local Networks . . . What's Up? Xerox is staking a big pile of money on the "office of the future" concept using its Ethernet local networking system. The system is intended for lawyers, engineers, analysts, and other professionals wishing to zip documents, data files, graphics, and so forth between offices. Xerox has introduced several pieces of Ethernet equipment of which the latest is the Star workstation. The Star can be used as a standalone system or as a communications device between other Stars, file servers, and even non-Xerox equipment via an Ethernet system.

The Star is very impressive. Xerox has invested a great deal of energy in developing a workstation with a highly intelligent user interface. In fact, a user can know next to nothing about computers and still use it proficiently because a four-hour machine-guided set of lessons is provided.

Star's most striking feature is its high-resolution video display that shows you two pages, side by side, exactly as they will appear in hard copy. You can vary character fonts, size detailed graphics, change gray tones, justify columns, move text on the screen, look into separate areas of different documents, and more. Using a standard keyboard, it has a free-roaming cursor controlled by a "mouse" and uses small graphic symbols to signify functions. No particular language is needed to tell the system what to do.

There is no doubt that the Star is ahead of the times—perhaps too far ahead! Despite support from several other vendors (Intel, Digital Equipment Corporation, and Hewlett-Packard), there is still no standard for exchanging information via Ethernet. At this time, the IEEE Local Networking Standard Committee appears hopelessly deadlocked. So there is no guarantee that a file created on an HP (Hewlett-Packard) computer, for example, will be compatible with Star's file-handling capabilities.

Even bigger problems are looming: each week there seems to be another new local-network system announced. Also, some of the personal-computer makers have indicated that they will introduce their own network systems, which, undoubtedly, will be non-Ethernet-compatible. Thus, we appear headed for chaos, where there will be neither hardware nor software compatibility among vendors.

On top of all of this, local networks are expensive: the Star workstation costs $17,000. The Ethernet coaxial cable costs an estimated $2 per foot, plus installation, and an Ethernet file server is more expensive than the Star. Hence, a Xerox Ethernet system appears to be prohibitively expensive for a small business. It is interesting to note that Xerox's new 820 system, with an under-$3000 price tag, does not include any Ethernet interfacing (of course, it could be introduced as an option).

Everyone is watching to see how well Xerox will do with Ethernet. You can be sure that several manufacturers have networking systems in advanced stages and, if they feel it is worthwhile, will quickly jump into the marketplace. This includes IBM, DEC, several personal-computer makers, and the Japanese.

Data-Processing Lawsuits and Awards Increasing: An estimated 600 computer-related lawsuits are before the courts. This is expected to surge up to 5000 by 1985, placing them second only to personal-injury cases.

A typical computer lawsuit costs a company $500,000 and takes seven years to complete. Most cases are the result of an adverse relationship between users and vendors. Users appear to be ignorant of what they are buying and expect the vendor to furnish a system to meet all their requirements, but vendors only offer standard systems. So there is a wide gulf between user expectations and vendor capabilities.

Other causes are poor machine reliability and poor system performance. Many suits involve undercapitalized small systems, software, and consulting firms that would rather sell the wrong machine or software package than to lose a sale. But vendors counter that purchasers are infatuated with the best and fastest hardware rather than concerning themselves with the problems to be solved. Also, many vendor contracts contain phrases that may waive warranties.

In a recent court case, NCR (National Cash Register) was ordered to pay the Glovatorium (a wholesale suede and leather cleaner) $2.3 million. The jury found NCR guilty of willfully selling the Glovatorium a minicomputer package it knew would not work. NCR claimed that it was protected from some of the award by a nonconsequential damages clause in the user contract. The judge overruled the clause, which held that NCR was not liable for any loss of business, profits, or consequential damages suffered by the user.

Newspaper Guild Wants Video-Display Terminals Probed: The president of the Newspaper Guild, Charles A Perlik Jr, has urged a congressional subcommittee to back testing of possible long-term effects on operators of video-display terminals. Perlik conceded that tests performed by the National Institute for Occupational Health and Safety have found the radiation to be minimal; however, he claimed that the incidence of cataracts among video-terminal users at newspapers was unusually high. He asserted that the test included only a small number of terminals in use. The Guild has arranged for the Mount Sinai School of Medicine to conduct a "wide-ranging study."

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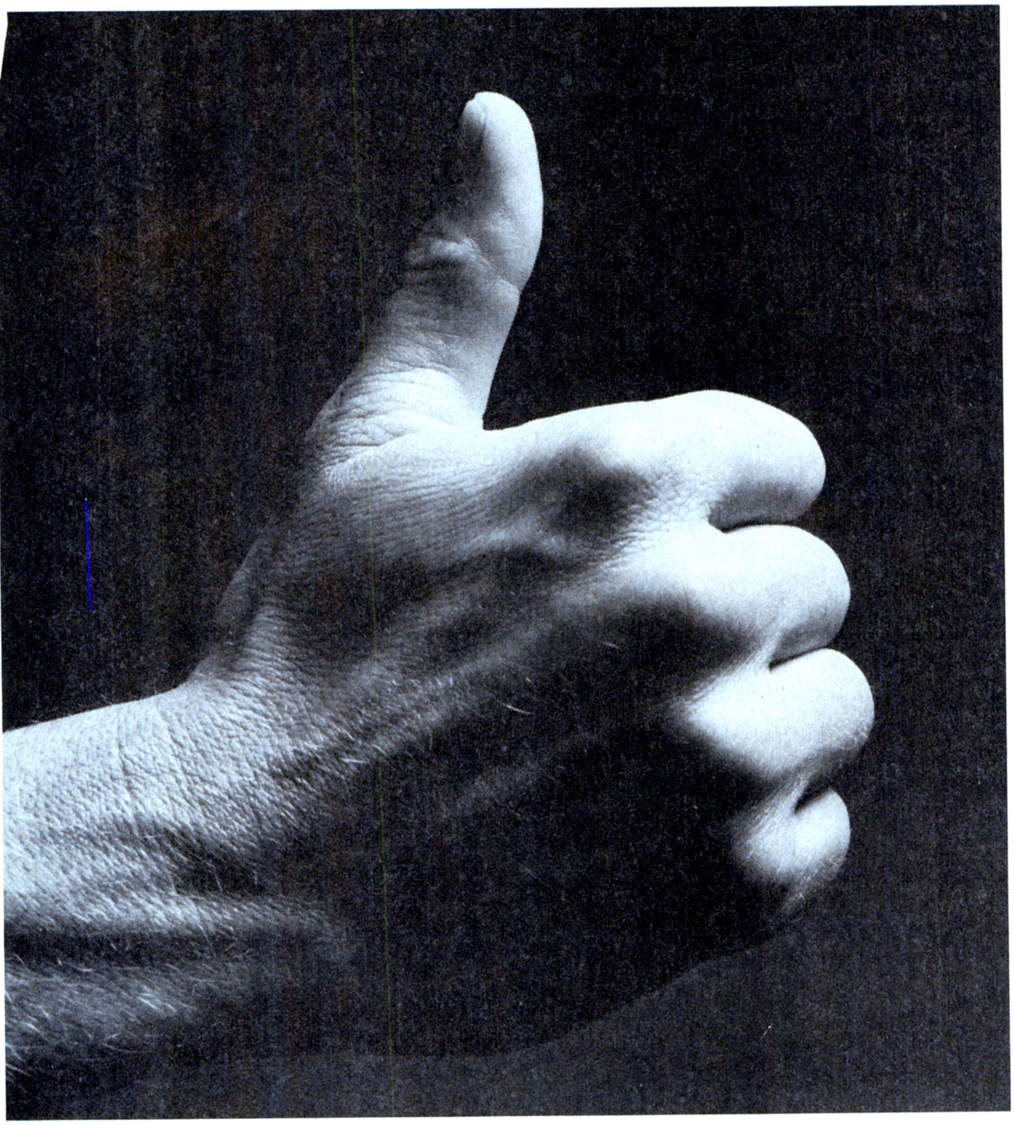

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Computer Crime On The Rise: Two recently reported crimes involved computers. In the first, a student at San Jose State University was arrested and charged with unauthorized access to systems throughout the state and possibly other countries. The student illegally bypassed the school's security system and used the time to play games with other students, some as far away as Sweden and Taiwan. In the process, he accumulated more than $7000 in long-distance telephone bills. He was also accused of erasing programs belonging to other students.

In the other case, a former programmer in Louisiana was arrested after admitting that he stole more than $100,000 in money orders from a system he had programmed. The programmer had been retained by a software house to remove bugs from a software package being prepared for a customer. In the process of "fixing" the program, he altered the software so that he could write checks that were ignored by the system; consequently, the losses were not revealed.

Computer Science Graduates Command High Starting Salaries: According to a survey conducted by the College Placement Council, this year's computer science college graduates commanded an average starting salary of $20,000. Only engineers—particularly petroleum specialists—earned more (averaging $26,000).

UNIX Vs CP/M: There is no doubt that CP/M is the de facto standard for 8-bit microcomputers. It has been implemented on virtually all 8-bit machines, including the TRS-80, Apple, Heath, Xerox, Wang, Hewlett-Packard, and many of the new Japanese desk-top microcomputers. However, as we move into the 16-bit machine and multiuser/multiprocessing era, CP/M's supremacy is being challenged by UNIX-like operating systems. The battle as to which will be dominant on 16-bit systems is just beginning to develop, and I estimate that it will take another year or two (or possibly three) to determine the victor, if indeed there is one. The battle of words is already raging within the Department of the Army's Readiness Command (DARCOM), in magazines, and on several bulletin-board systems.

The arguments: CP/M currently exists in only one unique version (2.2), compared to at least five versions of UNIX, with more to come when "UNIX-like" systems actually hit the market. UNIX is a multiuser system, while CP/M is a single-user system. File size on UNIX is limited to 1000 megabytes, for CP/M it's 8 megabytes, but both support random-access files. Currently, UNIX runs only on PDP-11-based machines, while CP/M runs on 8080-, 8085-, 8088-, 8086-, and Z80-based machines. UNIX employs a tree-directory structure with an infinite number of levels and path names, whereas CP/M has a dual-level directory structure with a limited path. Both systems allow linking files. There is complete device transparency and redirectability with UNIX, but this is limited in CP/M. UNIX's user interface is contained in a "shell" that is easily replaced. CP/M, however, uses a command control processor that is not easily replaced. UNIX has a complicated command language in comparison to CP/M. UNIX's commands have redirectable I/O (input/output). Only terminal I/O is redirectable in CP/M. UNIX has more extensive wild cards in addition to interprocessor information transfer (pipes) and coroutines, both of which are lacking in CP/M. UNIX has type-ahead, while CP/M may not. UNIX allows parallel processes but CP/M does not. CP/M is limited to 20 arguments, yet UNIX allows indirect command files with no limit to arguments. Conditional and construct execution of files are permitted only in UNIX. Also, UNIX allows shell variables and command substitution that CP/M does not provide.

Both have proven reliability, but UNIX provides better security. UNIX is written in the C language, and CP/M is written in PL/M and assembler. CP/M appears to have much more public-domain and commercial software available for it than does UNIX.

IBM Market Share Eroding: In 1956 when 100% of the computer industry was geared toward big mainframes, IBM shipped 55% of all the data-processing equipment and had a handful of competitors. With the introduction of the minicomputer in 1972, the number of competitors increased to over 600. Last year, because of the microcomputer, the number of computer manufacturers rose to 3000. Although IBM has introduced mini- and microcomputers, its share of units shipped has dropped to 25%.

Random News Bits: Digital Equipment Corporation claims to have more than 100,000 LSI-11 microcomputers in operation. . . . Advanced Micro Devices and Mostek are developing integrated circuits that should reduce the cost of an Ethernet interface from the current $1000 to under $100 by 1983. . . . Seagate Technology, Scotts Valley, California, has introduced a 12.76-megabyte version of a 5-inch Winchester-disk drive. . . . For the second year in a row, Fujitsu reported greater computer sales in Japan than IBM ($2.8 billion compared to $1.6 billion). But IBM reported greater net income ($174 million to $88 million). . . . A recent letter in the *New England Journal of Medicine* reported on a new malady termed "Space Invaders wrist." The symptoms were a reported stiffness and pain in the right wrist. The cause was traced to "a large number of rapid, repetitive arm movements" required to play the Space Invaders game. The optimal treatment is rest. . . . Japanese integrated-circuit makers expect to produce 2 million 64 K-bit dynamic memories per month by year's end. . . . The largest disk drive yet is being developed by Ibis Systems, Duarte, California: 5 gigabytes. . . . A four-color miniature printer that uses 2¼-inch-wide paper will be offered by Alps Electric, Rockville Center, New York. It will cost only $300. . . .

Random Rumors: Digital Reserach of Texas' Big Board single-board microcomputer is rumored to be the heart of the Xerox 820. . . . Xerox is reportedly considering the introduction of an under-$1000 personal computer. It has already built a prototype containing a Z80, 16 K bytes of programmable memory (expandable to 256 K bytes), 64 K bytes of read-only memory, an 80-character by 25-line color display with

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    OMAHA, NEBRASKA  78323

FROM: JOHN WILKINSON
      ASTRAL COMMUNICATIONS
      25 WINCHESTER DRIVE
      ALBANY, NY  12305

DEAR MR. MARZILLO:
   WE HAVE RECEIVED YOUR ORDER DATED
SEPTEMBER 12, AND WE HAVE CONTACTED
OUR SHIPPING DEPARTMENT.  YOUR NEW
ASTRAL 10-840 SHOULD BE ON ITS WAY
THIS AFTERNOON.  THANK YOU FOR
DEALING WITH ASTRAL

               JOHN WILKINSON
               SALES EXECUTIVE
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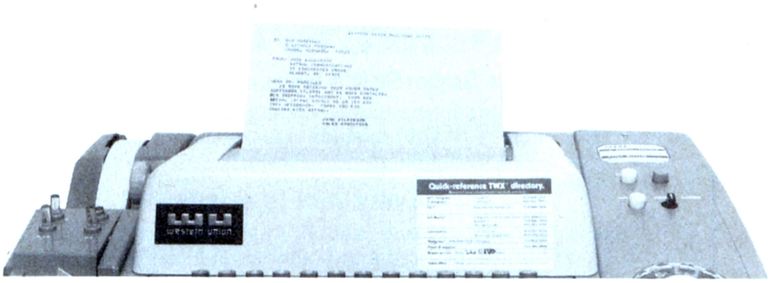

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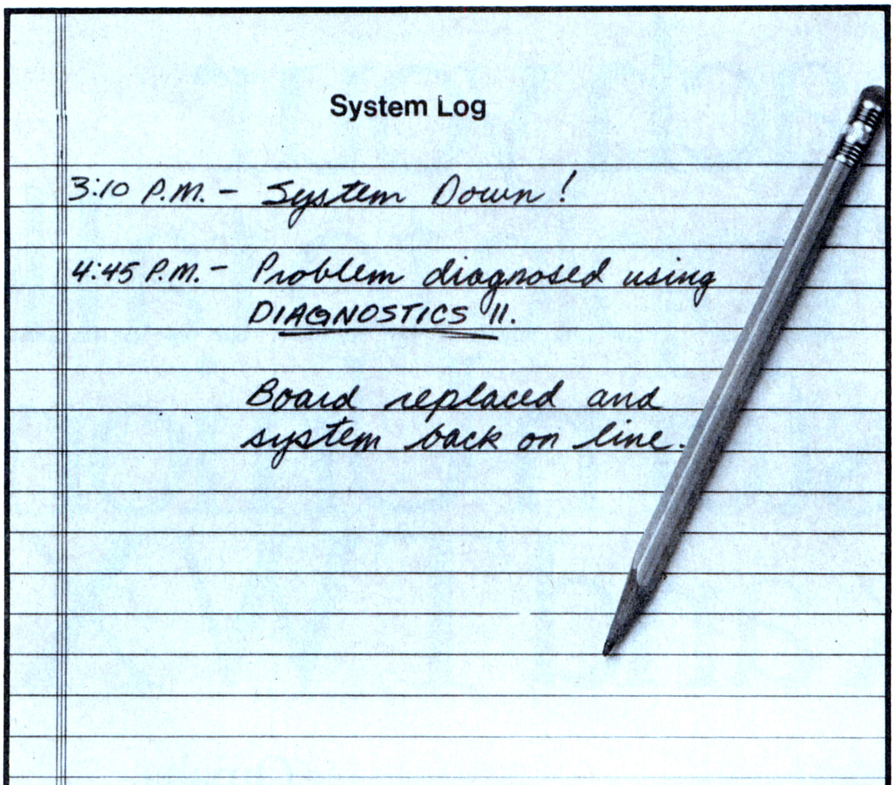
Circle 256 on inquiry card.



System Log
3:10 P.M. - System Down!
4:45 P.M. - Problem diagnosed using DIAGNOSTICS II.
Board replaced and system back on line.

DIAGNOSTICS II

Diagnostics II is SuperSoft's expanded Diagnostic package.

Diagnostic II builds upon the highly acclaimed Diagnostics I. It will test each of the five areas of your system:

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Every test is expanded.

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- printout of a graphic memory map
- burn in test
- bank selection option
- memory speed test

Diagnostics-II still includes the only CPU test for 8080/8085/Z80.

A Spinwriter/Diablo/Qume test has been added, which tests for the positioning and control features of the Spinwriter/Diablo/Qume as well as its ASCII printing features. (Serial Interface only)

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graphics capabilities, radio-frequency modulator, and liquid-crystal display. . . . The Apple IV could be released within the next few months. . . . IBM is said to be negotiating to implement BASIC and a VisiCalc-like package on its Displaywriter word-processing system, thereby acknowledging that it is really a general-purpose computer. . . . Expect about ten Japanese suppliers to enter the 5-inch hard-disk market by the end of next year, which should cause a softening of prices. . . . Rumor has it that a subset of Xerox's Smalltalk has been observed "chatting" at Apple Computer. . . .

MAIL: *I receive a large number of letters each month as a result of this column. If you write to me and wish a response, please include a self-addressed, stamped envelope.*

Sol Libes
POB 1192
Mountainside NJ 07081

BYTE's Bits

Logo License Applications Available

The Massachusetts Institute of Technology has announced that it is accepting applications from software distributors for the licensing of the Apple Logo Educational Software System. A review of the prototype of the system is available in the June 1981 BYTE (see page 36). Companies interested in further licensing information should contact: Patent, Copyright & Licensing Office, MIT, 77 Massachusetts Ave, Rm E19-722, Cambridge MA 02139.■

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T.M. LJK

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EASY TO USE — Letter Perfect is a single load easy to use program. It is a menu driven, character orientated processor with the user in mind. FAST machine language operation, ability to send control codes within the body of the program, mnemonics that make sense, and a full printed page of buffer space for text editing are but a few features. Screen Format allows you to preview printed text. Indented margins are allowed. Data Base Merge with **DATA PERFECT** by LJK, form letters, accounting files and mailing labels only with MAIL MERGE/UTILITY by LJK. **FEATURES** — Proportional/Incremental spacing * Right Justification * File Merging * Block movement * Headers * Footers * Print Multiple Copies * Auto Page Numbering * Scroll forward/backward * Search and Replaces * Full cursor control * Underlining * Boldface * Superscripts * Subscripts * Auto page numbering * Insert character/line * Delete character/line * Centering * Horizontal tabs/changeable * Multifunction format line (line spacing — left margin — page width — lines/page — change fonts — top/bot margin adjust) **MUCH MORE! $149.95**

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Compatible with Atari DOS. Uses proportional font, right justified with Atari 825/Centronics 737, 739 printers. Uses EPSON MX* Series + Graftrax/italicized font. Can mix type fonts on same page; mix boldface and enhanced font in same line with justification. Can be used with 16K Atari/400.*

"Compared to the price of many other word processors, this package is a steal. It does everything the advertisement claims and more. On top of this the software is very easy to use." **A.N.A.L.O.G. MAGAZINE**

APPLE VERSION 5.0 #1001

DOS 3.3 compatible — Use 40 or 80 column interchangeably (Smarterm — ALS; Videoterm-Videx; Full View 80 — Bit 3 Inc.; Vision 80 — Vista; Sup-R-Term — M&R Ent.) Reconfigurable at any time for different video, printer, or interface. **USE HAYES MICROMODEM II*** LCA necessary if no 80 column board, need at least 24 K of memory. Files saved as either Text or Binary. Shift key modification allowed. Data Base Merge compatible with **DATA PERFECT*** by LJK.

"For $150, Letter Perfect offers the type of software that can provide quality word processing on inexpensive micro-computer systems at a competitive price." **INFOWORLD**

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APPLE & ATARI DATA BASE MANAGEMENT

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Complete Data Base System. User orientated for easy and fast operation. 100% Assembly language. Easy to use. You may create your own screen mask for your needs. Searches and Sorts allowed, Configurable to use with any of the 80 column boards of Letter Perfect word processing, or use 40 column Apple video. Lower case supported in 40 column video. Utility enables user to convert standard files to Data Perfect format. Complete report generation capability. **Much More!**

EDIT 6502

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This is a coresident — two pass **ASSEMBLER, DISASSEMBLER, TEXT EDITOR, and MACHINE LANGUAGE MONITOR.** Editing is both character and line oriented. Disassemblies create editable source files with ability to use predefined labels. Complete control with 41 commands, 5 disassembly modes, 24 monitor commands including step, trace, and read/write disk. Twenty pseudo opcodes, allows linked assemblies, software stacking (single and multiple page) plus complete printer control, i.e. paganation, titles and tab setting. User can move source, object and symbol table anywhere in memory. Feel as if you never left the environment of **BASIC.** Use any of the 80 column boards as supported by **LETTER PERFECT,** Lower Case optional with **LCG.**

LJK DISK UTILITY

APPLE $29.95

This menu driven program allows the user to manipulate a variety of different file types. Binary, Text, and Source files may be easily converted into each other. The program may be used with **APPLESOFT*, VISCALC*,** and other programs. These program files may be readily adapted for multiple use including editing with **LETTER PERFECT** word processings.

$29.95

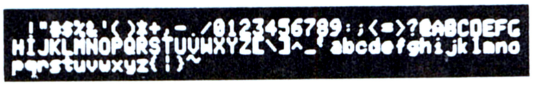
MAIL MERGE/UTILITY

APPLE & ATARI

This menu driven program combined with **LETTER PERFECT** allows user to generate form letters and print mailing labels. With the Atari, you may **CONVERT ATARI DOS FILES,** or Visicalc files compatible for editing with **LETTER PERFECT.** Utility creates Data Base files for Letter Perfect.

LOWER CASE CHARACTER GENERATOR

$34.95



```
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFG
HIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
pqrstuvwxyz{|}~
```

Lower Case Character Generator for the Rev. 7, Apple II or II+ computers. When installed, this Eprom will generate lower case characters to the video screen. Lower case characters set has two dot true descenders. Installation instruction included. Manual includes listing of software for full support and complete instructions for shift key modification. Compatible with **LETTER PERFECT.**

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CARD GAMES

BRIDGE 2.0 (Available for all computers) **Price: $17.95 Cassette/$21.95 Diskette**
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice. See the software review in 80 Software Critique. Rated #1 by Creative Computing.

HEARTS 1.5 (Available for all computers) **Price: $15.95 Cassette/$19.95 Diskette**
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies. HEARTS 1.5 is an ideal game for introducing the uninitiated (your spouse) to computers. See the software review in 80 Software Critique.

STUD POKER (Atari only) **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and *usually* bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound. See review in COMPUTE.

POKER PARTY (Available for all computers) **Price: $17.95 Cassette/$21.95 Diskette**
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple Cassette and diskette versions require a 32 K (or larger) Apple II.

CRIBBAGE 2.0 (TRS-80 only) **Price: $14.95 Cassette/$18.95 Diskette**
This is simply the best cribbage game available. It is an excellent program for the cribbage player in search of a worthy opponent as well as for the novice wishing to improve his game. The graphics are superb and assembly language routines provide rapid execution. See the software review in 80 Software Critique.

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star and CP/M only) **Price: $19.95 Cassette**
$23.95 Diskette
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) **Price: $17.95 Cassette/$21.95 Diskette**
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.

VALDEZ (Available for all computers) **Price: $15.95 Cassette/$19.95 Diskette**
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software review in 80 Software Critique.

BACKGAMMON 2.0 (Atari, North Star and CP/M only) **Price: $14.95 Cassette/$18.95 Diskette**
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHECKERS 3.0 (PET only) **Price: $16.95 Cassette/$20.95 Diskette**
This is one of the most challenging checkers programs available. It has 10 levels of play and allows the user to change skill levels at any time. Although providing a very tough game at level 4-8, CHECKERS 3.0 is practically unbeatable at levels 9 and 10.

CHESS MASTER (North Star and TRS-80 only) **Price: $19.95 Cassette/$23.95 Diskette**
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users. See review in onComputing.

LEM LANDER (32K Apple Disk only) **Price: $16.95 Diskette**
Pilot your LEM LANDER to a safe landing on any of nine different surfaces ranging from smooth to treacherous. The game paddles are used to control craft attitude and thrust. This is a real-time high res challenge!

FOREST FIRE! (Atari only) **Price: $16.95 Cassette/$20.95 Diskette**
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

NOMINOES JIGSAW (Atari, Apple and TRS-80 only) **Price: $16.95 Cassette/$20.95 Diskette**
A jigsaw puzzle on your computer! Complete the puzzle by selecting your pieces from a table consisting of 60 different shapes. NOMINOES JIGSAW is a virtuoso programming effort. The graphics are superlative and the puzzle will challenge you with its three levels of difficulty. Scoring is based upon the number of guesses taken and by the difficulty of the board set-up. See review in ELECTRONIC GAMES.

MONARCH (Atari only) **Price: $11.95 Cassette/$15.95 Diskette**
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy.

CHOMPELO (Atari only) **Price: $11.95 Cassette/$15.95 Diskette**
CHOMPELO is really two challenging games in one. One is similar to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. The other game is the popular board game REVERSI. It fully uses the Atari's graphics capability, and is hard to beat. This package will run on a 16K system.

SPACE LANES (Available for all computers) **Price: $14.95 Diskette**
SPACE LANES is a simple but exciting space transportation game which involves up to four players (including the computer). The object is to form and expand space transportation companies in a competitive environment. The goal is to amass more net worth than your opponent. The economics include stock purchases and company mergers. Watch your wealth grow!

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STARTREK 3.2 (Available for all computers) **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

BLACK HOLE (Apple only) **Price: $14.95 Cassette/$18.95 Diskette**
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

SPACE TILT (Apple and Atari only) **Price: $10.95 Cassette/$14.95 Diskette**
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

MOVING MAZE (Apple and Atari only) **Price: $10.95 Cassette/$14.95 Diskette**
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

ALPHA FIGHTER (Atari only) **Price: $14.95 Cassette/$18.95 Diskette**
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) **Price: $16.95 Cassette/$20.95 Diskette**
The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

INTRUDER ALERT (Atari only) **Price: $16.95 Cassette/$20.95 Diskette**
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

GIANT SLALOM (Atari only) **Price: $14.95 Cassette/$18.95 Diskette**
This real-time action game is guaranteed addictive! Use the joystick to control your path through slalom courses consisting of both open and closed gates. Choose from different levels of difficulty, race against other players or simply take practice runs against the clock. GIANT SLALOM will run on 16K systems.

TRIPLE BLOCKADE (Atari only) **Price: $14.95 Cassette/$18.95 Diskette**
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari and North Star only) **Price: $11.95 Cassette/$15.95 Diskette**
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle.

SPACE TRAP (Atari only, 16K) **Price: $14.95 Cassette/$18.95 Diskette**
This galactic "shoot'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) **Price: $21.95 Diskette**
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette.

GUMBALL RALLY ADVENTURE (North Star only, 48K) **Price: $21.95 Diskette**
Take part in this outlaw race from the east coast to the west coast. The goal is to find your way to the finish line while maintaining the highest possible speed. You may choose one of five cars available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!

SPEECH SYNTHESIS

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TNT Software

The following DYNACOMP programs are available for use with TNT:

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NOMINOES JIGSAW (Atari, 24K)
TEACHER'S PET I (Atari and North Star)
BRIDGE 2.0 (North Star)
CHOMPELO (Atari, 24K)

TALK TO ME (T'N'T Atari only, 24K) **Price: $14.95 Cassette/$18.95 Diskette**
This program presents a superb tutorial on speech synthesis using the Atari 800 and TYPE 'N TALK^{TM}. TALK TO ME will illustrate normal word generation as well as phoneme generation. The documentation includes many helpful programming tips.

Please specify 'TNT' versions when ordering.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 40 countries). During the past two years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique and A.N.A.L.O.G. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

**ATARI, PET, TRS-80, NORTHSTAR, CP/M and IBM are registered tradenames and/or trademarks.*

***Except where noted, all model I software is available for the Model III. TRS-80 diskettes are not supplied with DOS or BASIC.*

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BUSINESS and UTILITIES

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MAIL LIST 2.2 (Apple, Atari and North Star diskette only) — **Price: $34.95**

This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing (1, 2, or 3 up), merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. Mail List 2.2 will even find and delete duplicate entries. A very valuable program!

FORM LETTER SYSTEM rel. 2 (Atari, North Star and Apple Diskettes only) — **Price: $34.95**

FORM LETTER SYSTEM (FLS) is the ideal program for creating and editing form letters and address lists. It contains an easy-to-use text editor which produces fully justified text. Special codes are used in the address list to obtain personalized salutations. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage and sort your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $59.95.

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SORTIT is a general purpose sorting program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

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This is the second release version of DYNACOMP's popular TEXT EDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

DFILE (Atari and North Star diskettes only) — **Price: $19.95**

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FINDIT (North Star only) — **Price: $19.95**

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TAX OPTIMIZER (North Star only) — **Price: $59.95 Diskette**

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MISCELLANEOUS

CRYSTALS (Atari only) — **Price: $ 9.95 Cassette/$13.95 Diskette**

A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY

DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

DYNACOMP CASSETTES

DYNACOMP now offers high quality DYNACOMP brand name C-20 cassettes for computer use. Each cassette is guaranteed to be defect-free.

Box of 10 cassettes: $15.95 postpaid
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AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — **Price: $39.95 Cassette/$43.95 Diskette**

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — **Price: $19.95 Cassette/$23.95 Diskette**

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — **Price: $19.95 Cassette/$23.95 Diskette**

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — **Price: $24.95 Cassette/$28.95 Diskette**

HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $49.95 (three cassettes) and $59.95 (three diskettes).

REGRESSION I (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**

PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — **Price: $24.95 Cassette/$28.95 Diskette**

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Available for all computers) — **Price: $39.95 Cassette/$43.95 Diskette**

In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Volume 1

Collection #1: Chapters 2 and 3 - Data and function plotting; complex variables and functions.
Collection #2: Chapter 4 - Extended matrix and vector operations.
Collection #3: Chapters 5 and 6 - Random number generators (Poisson, Gaussian, etc.); series approximations.
Price per collection: $14.95 Cassette/$18.95 Diskette

All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).

Volume 2

Collection #1: Chapter 1 - Linear, polynomial, multidimensional, parametric least squares.
Collection #2: Chapter 2 - Series approximation techniques (economization, inversion, reversion, shifting, etc.).
Collection #3: Chapter 3 - Functional approximations by iteration and recursion.
Collection #4: Chapter 4 - CORDIC approximations to trigonometric, hyperbolic, exponential and logarithmic functions.
Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines).
Collection #6: Chapter 6 - Methods for finding the real roots of functions.
Collection #7: Chapter 7 - Methods for finding the complex roots of functions.
Collection #8: Chapter 8 - Optimization by steepest descent.
Price per collection: $14.95 Cassette/$18.95 Diskette

All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).
Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
BASIC SCIENTIFIC SUBROUTINES, Vol 2 (790 pages): $23.95 + $1.50 postage

See reviews in KILOBAUD and Dr. Dobbs.

ROOTS (Available for all computers) — **Price $10.95 Cassette/$14.95 Diskette**

In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

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ACAP is the analog circuit designer's answer to LOGIC SIMULATOR. With ACAP you may analyze the response of an active or passive component circuit (e.g., a transistor amplifier, band pass filter, etc.). The circuit may be probed at equal steps in frequency, and the resulting complex (i.e., real and imaginary) voltages at each component juncture examined. By plotting the magnitude of these voltages, the frequency response of a filter or amplifier may be completely determined with respect to both amplitude and phase. In addition, ACAP prints a statistical analysis of the range of voltage responses which result from tolerance variations in the components. ACAP is easy to learn and use. Simply describe the circuit in terms of the elements and their placement, and execute. Circuit descriptions may be saved onto cassette or diskette to be recalled at a later time for execution or editing. ACAP should be part of every circuit designer's program library.

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With LOGIC SIMULATOR you may easily test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. The response of the system is available every clock cycle. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. At the user's option, a timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

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The Atari Tutorial

Part 3: Player-Missile Graphics

Chris Crawford
Atari Inc
1265 Borregas Ave
POB 427
Sunnyvale CA 94086

Animation is an important capability of any personal computer system. Activity on the screen adds greatly to the excitement and realism of any program. Certainly, animation is crucial to the appeal of most computer games. More important, an animated image can convey information with more impact and clarity than a static image. It can draw attention to an item or event of importance. It can directly show a dynamic process, rather than indirectly talk about it. Animation must accordingly be regarded as an important element of the graphics capabilities of any computer system.

The conventional way to implement animation with personal computers is to move the image data through the screen memory area. This is a two-step process. First, the program must erase the old image by writing background values (ie: the values of the image "under" the moving one) to the memory containing the current image. Then the program must write the image data to the memory corresponding to the new position of the image. By repeating this process over and over, the image appears to move on the screen.

The essence of the problem of playfield animation: the screen image is two-dimensional, while the image in memory is one-dimensional.

There are two problems with this technique. First, if the animation is being done in a graphics mode with large pixels (picture elements), the motion will not be smooth; the image will jerk across the screen. With other computers, the only solution is to use a graphics mode with smaller pixels (higher resolution). The second problem is much worse. The screen is a two-dimensional image, but the screen memory is organized one-dimensionally. An image that is contiguous on the screen will not be contiguous in the screen memory. The discrepancy is illustrated in figure 1.

The significance of this discrepancy is not obvious until you try to write a program to move such an image. Look how the bytes that make up the image are scattered through memory. To erase them, your program must calculate their addresses. This calculation is not always easy to do. The assembly code just to access a single screen byte at screen location (XPOS,YPOS) would be as shown in listing 1 (this code assumes 40 bytes per screen line).

Clearly, this code to access a screen location is too cumbersome. It is not the most elegant or fastest code to solve the problem. A good programmer could take advantage of special circumstances to make the code more compact or elegant. The point of this is that accessing pixels on a screen takes a lot of computing. The routine in listing 1 takes about 100 machine cycles to access a single byte on the screen. To move an image that occupies, say 50 bytes, would require 100 accesses, 10,000 machine cycles, or roughly 10 ms. This may not sound like much, but if you want to achieve smooth motion, you have to move the object every 17 ms. If there are other objects to move or calcula-

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OUR SECOND GENERATION DP-NET

We at Delta Products have been involved in 'NETWORKING SYSTEMS' for the past eighteen months. During this time we delivered our first net systems to beta test sites. These closely monitored field installations provided invaluable data, which Delta Products has incorporated into the design of our second generation of DP-NET systems.

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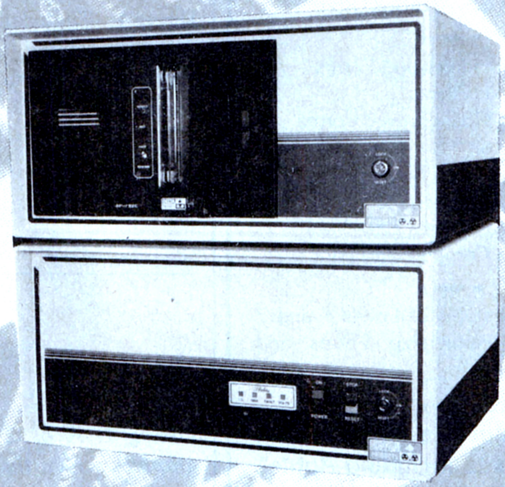

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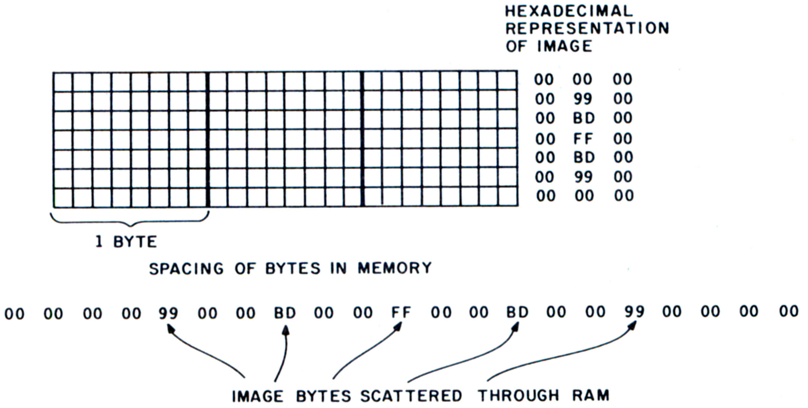
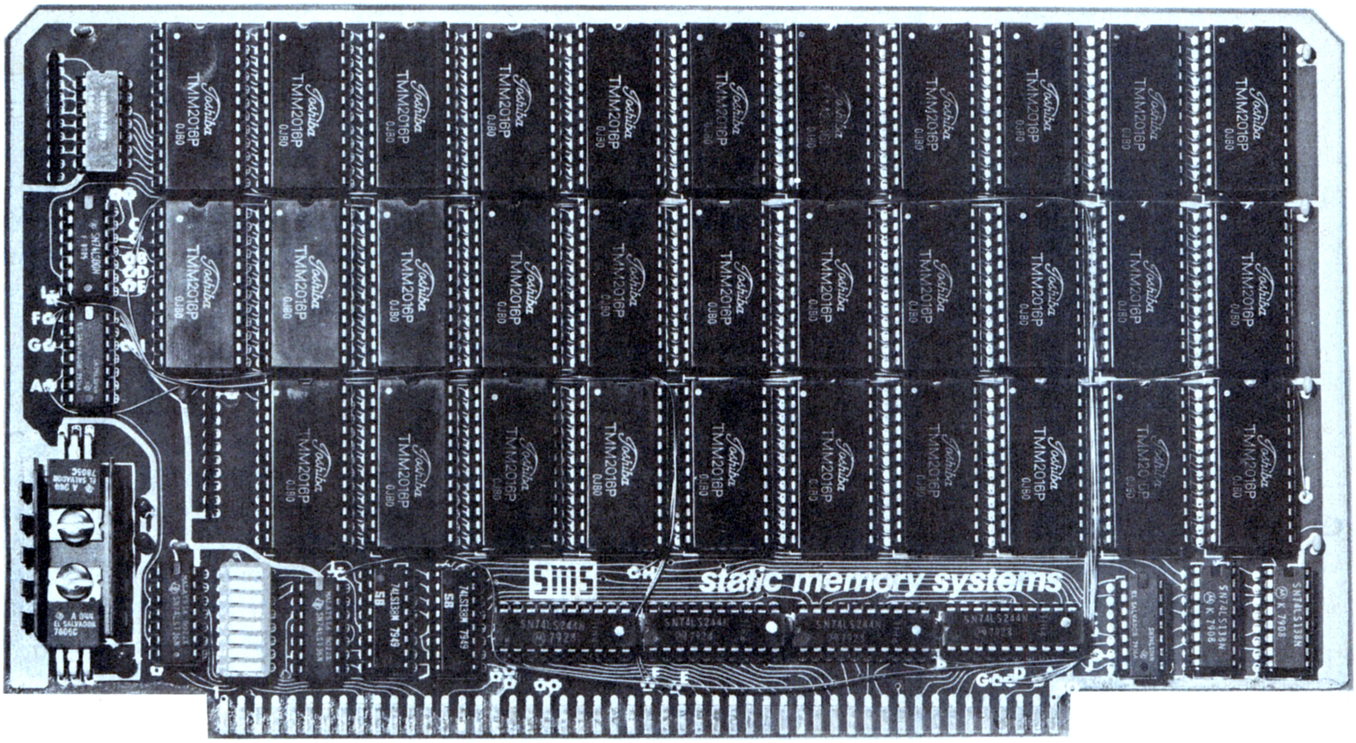

HEXADECIMAL REPRESENTATION OF IMAGE
00 00 00
00 99 00
00 BD 00
00 FF 00
00 BD 00
00 99 00
00 00 00
1 BYTE
SPACING OF BYTES IN MEMORY
00 00 00 00 99 00 00 BD 00 00 FF 00 00 BD 00 00 99 00 00 00 00
IMAGE BYTES SCATTERED THROUGH RAM

Figure 1: *The problem of moving a bit-mapped graphics image. Although the image is two-dimensional, its representation is scattered through one-dimensional memory. The software necessary to change the appropriate memory locations slows down animation considerably.*

Listing 1: *A 6502 assembly-language program to move a bit-map image within a graphics screen that uses 40 bytes per line of graphics.*

```
LDA   SCRNRM        Address of beginning of screen RAM
STA   POINTR        zero-page pointer
LDA   SCRNRM+1      high-order byte of address
STA   POINTR+1      high-order pointer
LDA   #$00
STA   TEMPA+1       temporary register
LDA   YPOS          vertical position
ASL   A             times 2
ROL   TEMPA+1       shift carry into TEMPA+1
ASL   A             times 4
ROL   TEMPA+1       shift carry again
ASL   A             times 8
ROL   TEMPA+1       shift again
LDX   TEMPA+1       save YPOS*8
STX   TEMPB+1       into TEMPB
STA   TEMB          low byte
ASL   A             times 16
ROL   TEMPA+1
ASL   A             times 32
ROL   TEMPA+1
CLC
ADC   TEMPB         add in YPOS*8 to get YPOS*40
STA   TEMPB
LDA   TEMPA+1       now do high-order byte
ADC   TEMPB+1
STA   TEMPB+1
LDA   TEMPB         TEMPB contains the offset from top of screen to pixel
CLC
ADC   POINTR
STA   POINTR
LDA   TEMPB+1
ADC   POINTR+1
STA   POINTR+1
LDY   XPOS
LDA   (POINTR),Y
```

THE LAST MEMORY



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At last a 64K *STATIC* memory board for S100 systems. But it's not just a 64K static RAM board, *EPROM's* can also be intermixed with RAM making it the only memory board needed for S100 systems. That's why we call it **THE LAST MEMORY.**

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tions to carry out, the 7 ms difference doesn't allow much processor time to devote to them. This means that this type of animation (called *playfield animation*) is too slow for many purposes. You can still get animation this way, but you are limited to a few objects, small objects, slow motion, or a few calculations between motion. The trade-offs a programmer must make in using such animation are too restrictive.

A New Approach—Players

The Atari 400/800 solution to this problem is player-missile graphics. In order to understand player-missile graphics, you must understand the essence of the problem of playfield animation: the screen image is two-dimensional, while the image in memory is one-dimensional. The solution was to create a graphics object that is one-dimensional on the screen, as well as one-dimensional in memory. This object (called a *player*) appears in memory as a table either 128 or 256 bytes long. The table is mapped directly to the screen. It appears as a vertical band stretching from the top of the screen to the bottom. Each byte in the table is mapped into either one or two horizontal scan lines, with the choice made by the programmer. The screen image is a simple bit-map of the data in the table. If a bit is on, the corresponding pixel in the vertical column is lit; if the bit is off, the corresponding pixel is off. Thus, the player image is not strictly one-dimensional; it is actually 8 bits wide.

Drawing a player image on the screen is simple. First, you draw a picture of the desired image on graph paper. This image must be no more than eight pixels wide. Then you translate the image into binary code, substituting 1s for illuminated pixels and 0s for empty pixels. You translate the resulting binary number into decimal or hexadecimal (depending on which is more convenient), and you store 0s into the player memory area to clear the image. Next, you store the image data into the player memory area, with the byte at the top of the player image going first, followed by the other image bytes in top-to-bottom sequence. The further down in memory you place the data, the lower the image will appear on the screen.

Animating this image is easy. Vertical motion is obtained by moving the image data through the player memory. This is, in principle, the same method used in playfield animation, but there is a big difference in practice. The move routine for vertical motion is a one-dimensional move instead of a two-dimensional move. The program does not need to multiply by 40 and it often does not need to use indirection. It could be as simple as:

```
        LDX   #$01
LOOP    LDA   PLAYER,X
        STA   PLAYER-1,X
        INX
        BNE   LOOP
```

This routine takes about 4 ms to move the entire player, about half as

What Is Shadowing?

Some of the hardware registers talked about in this article are write-only*—that is, you can write values to them, but you can't read what their current contents are. Because of this, the designers of the Atari operating system created* shadow registers *for some of the more important hardware registers. When the Atari 400/800 has finished drawing an entire display screen of information (at a time called the* vertical blank*), it copies the contents of each shadow register into the corresponding hardware register (this occurs every 1/30 second). In this way, you can read the contents of a shadow register, knowing that it has the same value as its hardware register.*

If you write to the hardware register itself, the old value (still in the shadow register) will be copied into the hardware register at the next vertical blank, and whatever effect you wanted to make will be almost instantly undone. Similarly, if you try to read the hardware-register location, you will get incorrect results.

To conclude, you should always read from and write to shadow registers where they exist. If you fail to do so, your program will fail to work in a way that is not always obvious.

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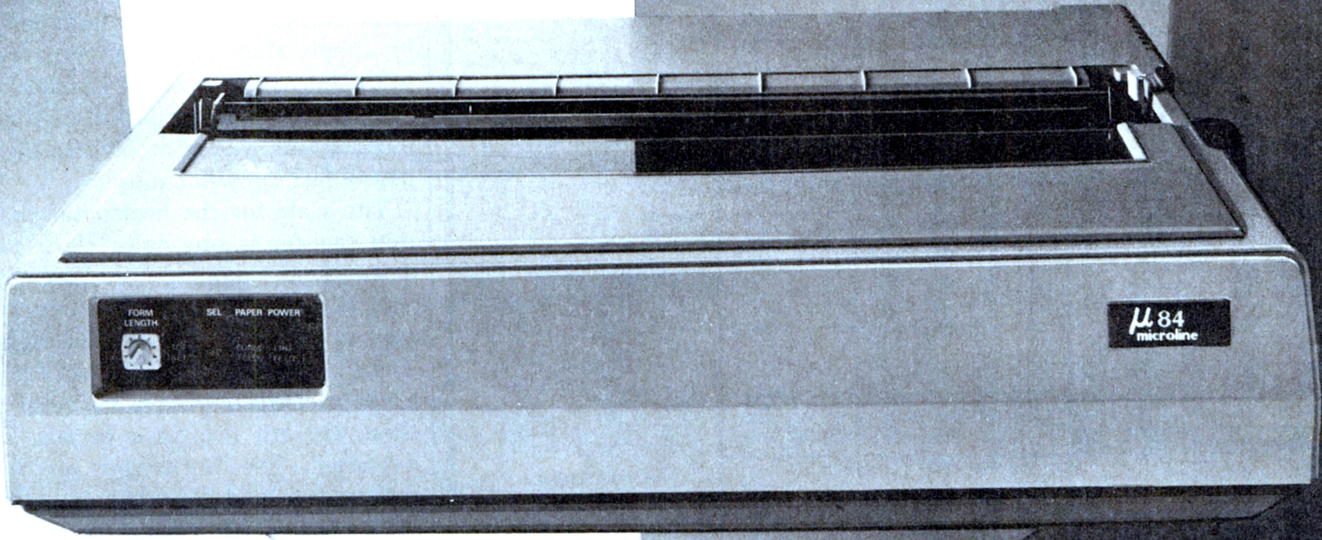

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long as the playfield-animation routine. The player-movement routine is faster than the playfield-animation routine, even though the former moves 256 bytes and the latter moves 50 bytes. If high speed is necessary, the loop above can be trimmed to move only the image bytes themselves, rather than the whole player. Then the loop would easily run in about 100 to 200 μs. The point here is that vertical motion with players is both simpler and faster than motion with playfield objects.

Players and missiles are independent of the playfield—you can mix them with any text or graphics.

Horizontal motion is even easier than vertical motion. There is a register for the player called the *horizontal position register*. The value in this register sets the horizontal position of the player on the screen (ie: the distance from the left edge of the screen). All you do is store a number into this register and the player jumps to that horizontal position. To move the player horizontally, simply change the number stored in the horizontal position register.

Horizontal and vertical motion are independent; you can combine them in any fashion you choose.

The scale for the horizontal position register is one color clock per unit. Thus, adding one to the horizontal position register moves the player one color clock to the right. There are only 228 color clocks in a single scan line. Furthermore, some of these are not displayed because of overscan. The horizontal position register can hold 256 positions, some off the left or right edge of the screen. Depending on the overscan of the television, positions 0 through 44 will be off the left edge of the screen and positions 220 through 255 will be off the right edge. Thus, the visible region of the player is in horizontal positions 44 through 220. Remember, however, that this may vary from

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The system described so far makes it possible to produce high-speed animation. There are a number of embellishments that greatly add to its overall utility. The first embellishment is that there are four independent players to use. These players all have their own sets of control registers and memory areas; thus, their operation is completely independent. The players are labeled P0 through P3. They can be used side by side to give up to 32 bits of horizontal resolution, or independently to give four movable objects. Each player has its own color register, completely independent of the playfield color register. The player color registers are called COLP(X) and are shadowed at PCOLR(X). This gives you the capability to put much more color onto the screen. However, each player has only one color; multicolored players are not possible without *display-list interrupts* (which will be discussed in the next article in this series).

Each player has a controllable width. You can set it to have normal width, double width, or quadruple width with the SIZEP(X) registers. This is useful for making players take on different sizes. You also have the option of choosing the vertical resolution of the players. You can use single-line resolution, in which each byte in the player table occupies one horizontal scan line, or double-line resolution, in which each byte occupies two horizontal scan lines. With single-line resolution, each player bit-map table is 256 bytes long; with double-line resolution, each table is 128 bytes long. This is the only case where player properties are not independent. The selection of vertical resolution applies to *all* players. Player vertical resolution is controlled by bit D4 of the DMACTL

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register. In double-line resolution, the first 10 bytes in the player table area are lost to vertical overscan and are off the top edge of the screen, and the last 20 bytes are lost off the bottom edge of the screen. In single-line resolution, 20 and 40 bytes are lost correspondingly.

Missiles

The next embellishment is the provision of *missiles*. These are 2-bit-wide graphics objects associated with the players. There is one missile assigned to each player; it takes its color from the player's color register. Missile-shape data come from the missile bit-map table in memory in front of the player tables. All four missiles are packed into the same table (four missiles times 2 bits per missile gives 8 bits). Missiles can move independently of players; they have their own horizontal position registers. Missiles have their own size register, SIZEM, that can set the horizontal width as the SIZEP(X) registers do for players. However, missiles cannot be set to different sizes. They are all set together. Missiles are useful as bullets or for skinny vertical lines on the screen. If desired, the missiles can be grouped together into a fifth player, in which case they take the color of playfield color register 3. This is done by setting bit D4 of the priority control register (PRIOR). Missiles can still move independently when this option is in effect. Their horizontal positions are set by their horizontal position registers (HPOSM0 through HPOSM3). Their shapes and vertical positions are determined by which bits are turned on in their area of the player-missile area (see figures 2a and 2b). The fifth player enable bit only affects the color of the missiles.

You move a missile vertically the same way you move a player: by moving the missile-image data through their two bit-positions of the missile memory area. This can be difficult to do because missiles are grouped into the same memory table. To access a single missile, you must ignore the bits for the other missiles.

An important feature of player-missile graphics is that players and missiles are completely independent of the playfield (ie: the text or graphics information also displayed by the computer). You can mix them with *any* text or graphics mode. This raises a problem: What happens if a player ends up on top of a playfield image? Which image has priority? You have the option to define the priorities used in displaying players.

Four priority schemes are possible (see the listing for register PRIOR in appendix B). If you wish, all players can have priority over all playfield color registers. Or you can set all playfield color registers (except background) to have priority over all players. Or you can set player 0 and player 1 (P0 and P1) to have priority over all playfield color registers, with P2 and P3 having less priority than the playfield. Or you can set playfield color registers 0 and 1 (PF0 and PF1) to have priority over all players, which then have priority over PF2 and PF3. These priorities are selected with the priority control register (PRIOR) that is shadowed at GPRIOR. This capability allows a player to pass in front of one image and behind another, allowing three-dimensional effects.

Who Did I Just Hit?

The final embellishment is the provision for hardware collision detection. This is primarily of value for games. You can check if any graphics object (player or missile) has collided with anything else. Specifically, you can check for missile-player collisions, missile-playfield collisions, player-player collisions, and player-playfield collisions. There are fifty-four possible collisions, each one with a bit assigned to it that can be checked. If the bit is set, a collision has occurred. These bits are mapped into fifteen registers in CTIA (another custom integrated circuit in the Atari 400/800); only the lower 4 bits are used and some are not meaningful. These are read-only registers; they cannot be cleared by writing zeros to them. The registers can be cleared for further collision detection by writing any value to register HITCLR. All collision registers are cleared by this command.

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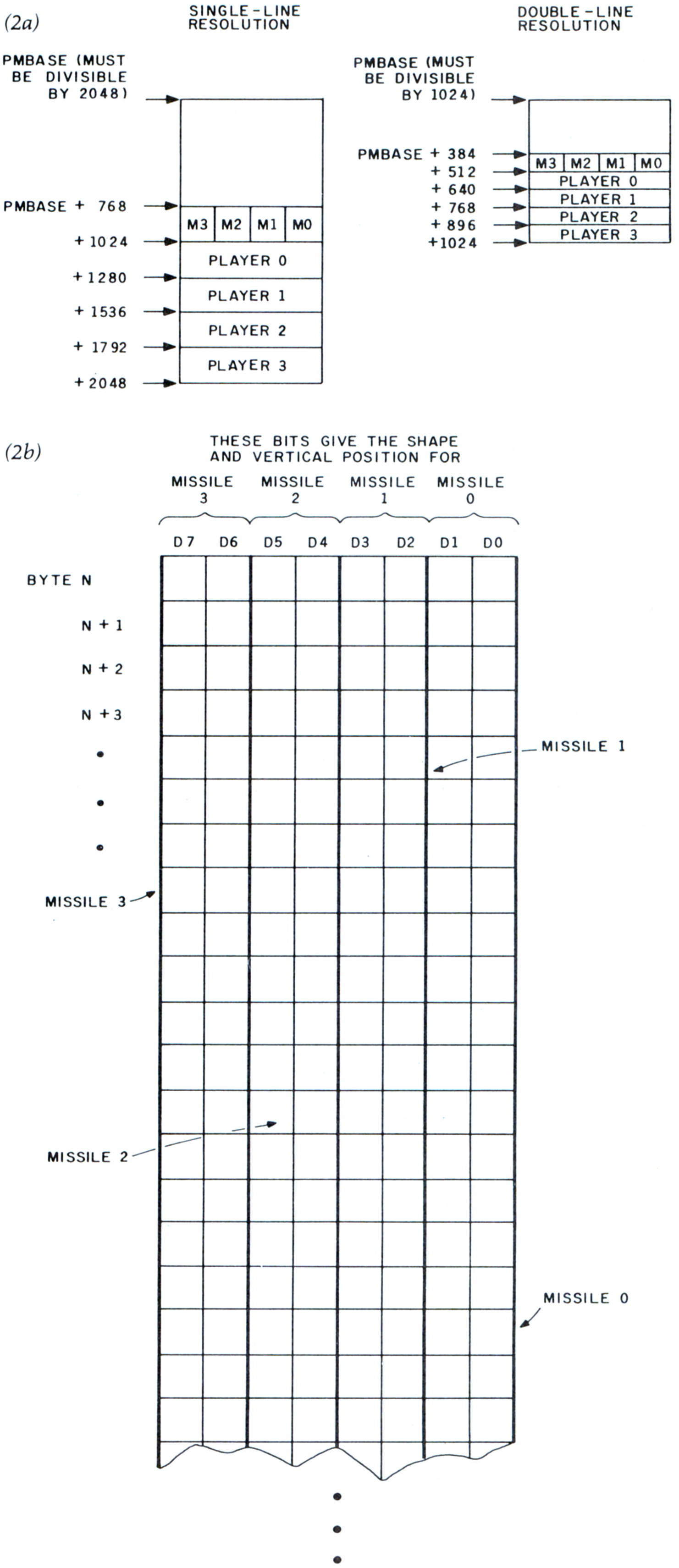
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M3
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(2b)
THESE BITS GIVE THE SHAPE AND VERTICAL POSITION FOR
MISSILE 3
MISSILE 2
MISSILE 1
MISSILE 0
D7
D6
D5
D4
D3
D2
D1
D0
BYTE N
N + 1
N + 2
N + 3
MISSILE 1
MISSILE 3
MISSILE 2
MISSILE 0

Figure 2: *The player-missile area. Information on the shape and vertical position of the players and missiles is kept in a block of memory. The allocation for single-line and double-line player-missile areas is shown in figure 2a. Figure 2b shows how one area can store the shape and position of four missiles.*

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In hardware terms, collisions occur when a player image coincides with another image. Thus, the collision bit will not be set until the part of the screen showing the collision is drawn. This means that collision detection might not occur until as many as 16 ms have elapsed since the player was moved. The preferred solution is to execute player motion and collision detection during the vertical-blank interrupt routine. In this case, collision detection should be checked first, then collisions cleared, then players moved. Another solution is to wait at least 16 ms after moving a player before checking for a collision involving that player.

Using Player-Missile Graphics

There are a number of steps necessary to use player-missile graphics. First, you must set aside an area of RAM (random-access read/write memory) as a player-missile area and tell the computer where it is. If you use single-line resolution, this area will be 1280 bytes long; if you use double-line resolution, it will be 640 bytes long. A good practice is to use the memory area in front of the display area at the top of the computer's available RAM. The layout of the player-missile area is shown in figure 2.

The pointer to the beginning of the player-missile area is labeled

Listing 2: *An Atari BASIC program that draws a player on the screen and allows the user to move the figure with a joystick.*

```
  1  PMBASE = 54279:REM                   player-missile base pointer
  2  RAMTOP = 106:REM                     OS top of RAM pointer
  3  SDMCTL = 559:REM                     RAM shadow of DMACTL register
  4  GRACTL = 53277:REM                   CTIA graphics control register
  5  HPOSP0 = 53248:REM                   horizontal position of P0
  6  PCOLR0 = 704:REM                     shadow of player 0 color
 10  GRAPHICS 0:SETCOLOR 2,0,0:REM        set background color to black
 20  X = 100:REM                          BASIC's player horizontal position
 30  Y = 48:REM                           BASIC's player vertical position
 40  A = PEEK(RAMTOP) - 8:REM             get RAM 2 K below top of RAM
 50  POKE PMBASE,A:REM                    tell ANTIC where PM RAM is
 60  MYPMBASE = 256*A:REM                 keep track of PM RAM address
 70  POKE SDMCTL,46:REM                   enable PM DMA with 2-line res
 80  POKE GRACTL,3:REM                    enable PM display
 90  POKE HPOSP0,100:REM                  declare horizontal position
100  FOR I = MYPMBASE + 512 TO
     MYPMBASE + 640:REM                   this loop clears player
110  POKE I,0
120  NEXT I
130  FOR I = MYPMBASE + 512 + Y TO
     MYPMBASE + 518 + Y
140  READ A:REM                           this loop draws the player
150  POKE I,A
160  NEXT I
170  DATA 8,17,35,255,32,16,8
180  POKE PCOLR0,88:REM                   make the player pink
190  A = STICK(0):REM                     read joystick
200  IF A = 15 THEN GOTO 190:REM          if inactive, try again
210  IF A = 11 THEN X = X - 1:POKE HPOSP0,X
220  IF A = 7 THEN X = X + 1:POKE HPOSP0,X
230  IF A< >13 THEN GOTO 280
240  FOR I = 8 TO 0 STEP -1
250  POKE MYPMBASE + 512 + Y + I,PEEK
     (MYPMBASE + 511 + Y + I)
260  NEXT I
270  Y = Y + 1
280  IF A< >14 THEN GOTO 190
290  FOR I = 0 TO 8
300  POKE MYPMBASE + 511 + Y + I,PEEK
     (MYPMBASE + 512 + Y + I))
310  NEXT I
320  Y = Y - 1
330  GOTO 190
```

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1	RULE78	Interest Apportionment by Rule of the 78's
2	ANNU1	Annuity computation program
3	DATE	Time between dates
4	DAYYEAR	Day of year a particular date falls on
5	LEASEINT	Interest rate on lease
6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model

	NAME	DESCRIPTION
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
98	SALELEAS	Sale-leaseback analysis
99	RRCONVBD	Investor's rate of return on convertable bond
100	PORTVAL9	Stock market portfolio storage-valuation program

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PMBASE. Because of internal limitations of the ANTIC device (a custom integrated circuit in the Atari computers), PMBASE must be on a 1 K-byte boundary for single-line resolution, or a 2 K-byte boundary for double-line resolution. If you elect to use less than four players or none of the missiles, the areas of memory set aside for the unused objects may be used for other purposes. Once you decide where your player-missile area will be, you inform ANTIC of this by storing the page number of PMBASE into the PMBASE register in ANTIC.

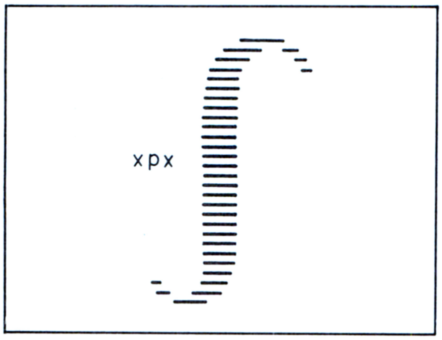

Figure 4: *Use of a player as a special symbol. This can be done because players and missiles are superimposed over whatever text or graphics are in effect.*

The next step is to clear the player and missile areas by storing zeros into all locations in the player-missile memory area. Then draw the players and missiles by storing image data into the appropriate locations in the player-missile area.

Next, set the player parameters by setting the player color, horizontal position, and width registers to their initial values. If necessary, set the player/playfield priorities. Inform ANTIC of the vertical resolution desired by setting bit D4 of register DMACTL (shadowed at SDMCTL) for single-line resolution and clearing the bit for double-line resolution. Finally, enable the players by setting the appropriate bits in DMACTL. Be careful not to disturb the other bits in DMACTL. A sample BASIC program for setting up a player and moving it with the joystick is given in listing 2.

Once players are displayed, they can be difficult to remove from the screen because the procedure by which they are displayed involves several steps. First, the ANTIC integrated circuit retrieves player-missile data from the player-missile area RAM (if such retrieval is enabled in the DMACTL register). Then ANTIC ships the player-missile data to the CTIA integrated circuit (if such action is enabled in the GRACTL register). CTIA displays whatever is in its player and missile graphics registers (GRAFP0 through GRAFP3 and GRAFM). Many programmers attempt to turn off player-missile graphics by clearing the control bits in DMACTL and GRACTL. This only prevents ANTIC from sending new player-missile data to CTIA; the old data in the GRAF(X) registers will still be displayed. To completely clear the players, the GRAF(X) registers must be cleared after the control bits in DMACTL and GRACTL have been cleared. A simpler solution is to leave the player up, but set its horizontal position to zero. Of course, if this solution is used, ANTIC will continue to use DMA to retrieve player-missile data, wasting roughly 10,000 machine cycles (about 10 ms) per second.

Uses

Player-missile graphics allow a number of special capabilities. They are of great value in animation. They do have limitations: there are only four players and each is only 8 bits wide. If you need more bits of horizontal resolution, you can always fall back on playfield animation. But for high-speed or quick-and-dirty animation, player-missile graphics work very well.

It is possible to bypass ANTIC and write player-missile data directly into the player-missile graphics registers (GRAFP(X)) in the CTIA integrated circuit. This gives the programmer

Listing 3: *An Atari BASIC program to create a pseudoplayer with increased resolution. See the text and figure 3 for details.*

```
  1 RAMTOP=106:REM                         OS top of RAM pointer
  2 PMBASE=54279:REM                       ANTIC player-missile RAM
                                           pointer
  3 SDMCTL=559:REM                         shadow of DMACTL
  4 GRACTL=53277:REM                       CTIA graphics control register
  5 HPOSP0=53248:REM                       horizontal position register of P0
  6 PCOLR0=704:REM                         shadow of player 0 color
                                           register
  7 SIZEP0=53256:REM                       player width control register
  8 GPRIOR=623:REM                         priority control register
 10 GRAPHICS 7
 20 SETCOLOR 4,8,4
 30 SETCOLOR 2,0,0
 40 COLOR 3
 50 FOR Y=0 TO 79:REM                      this loop fills the screen
 60 PLOT 0,Y
 70 DRAWTO 159,Y
 80 NEXT Y
 90 A=PEEK(RAMTOP)-20:REM                  must back up further for GR.7
100 POKE PMBASE,A
110 MYPMBASE=256*A
120 POKE SDMCTL,46
130 POKE GRACTL,3
140 POKE HPOSP0,100
150 FOR I=MYPMBASE+512 TO MYPMBASE
    +640
160 POKE I,255:REM                         make player solid color
170 NEXT I
180 POKE PCOLR0,88
190 POKE SIZEP0,3:REM                      set player to quadruple width
200 POKE GPRIOR,4:REM                      set priority
210 COLOR 4
220 FOR Y=30 TO 40
230 PLOT Y+22,Y
240 DRAWTO Y+43,Y
250 NEXT Y
```

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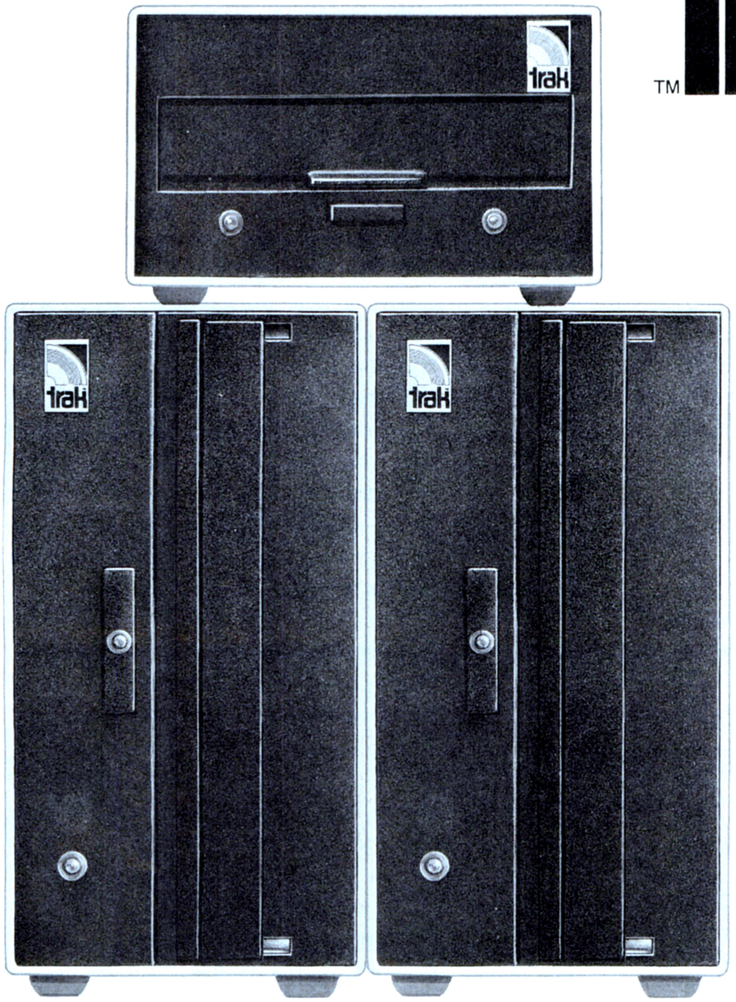

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more direct control over player-missile graphics. As a result, it also increases his or her responsibilities. The programmer must maintain a bitmap of the player-missile data and move it into the graphics registers at the appropriate times. The 6502 must therefore be slaved (ie: synchronized to and triggered by) to the screen drawing cycle. This is a clumsy technique that offers minor performance improvements in return for major programming efforts. The programmer who bypasses the hardware power offered by ANTIC must make up for it with his or her own sweat.

Player-missile graphics offer many capabilities in addition to animation. Players are an excellent way to increase the amount of color in a display. The four additional color registers provided allow four more colors on each line of the display. Of course, the 8-bit resolution does limit the range of their application.

There is a way around this limitation that can sometimes be used. Take a player at quadruple width and put it onto the screen. Then set the priorities so the player has lower priority than a playfield color. Next, reverse that playfield color with background, so the apparent background color of the screen is really a playfield color. The player disappears behind this new false background. Cut a hole in the false background by drawing true background on it. The player will show up in front of the true background color, but only in the area where true background has been drawn. In this way, the player can have more than 8 bits of horizontal resolution. A sample program for doing this is given in listing 3. This program produces the display shown in figure 3.

Another application of player-missile graphics is for special characters. There are many special types of characters that cross vertical boundaries in normal character sets. One way to deal with these is to create special character sets that address this problem. Another way is to use a player. Subscripts, integral signs, and other special symbols can be done this way. A sample program for doing this is given in listing 4. This program produces the display shown in figure 4.

A particularly useful application of players is for cursors. With their ability to smoothly move anywhere over the screen without disturbing the contents, they are ideally suited for such applications. The cursor can change color as it moves over the screen to indicate what it has under it.

Player-missile graphics provide many capabilities. Their uses for action games as animated objects are obvious. They have many serious uses as well. They can add color and resolution to any display. They can present special characters. They can be used as cursors. Use them.■

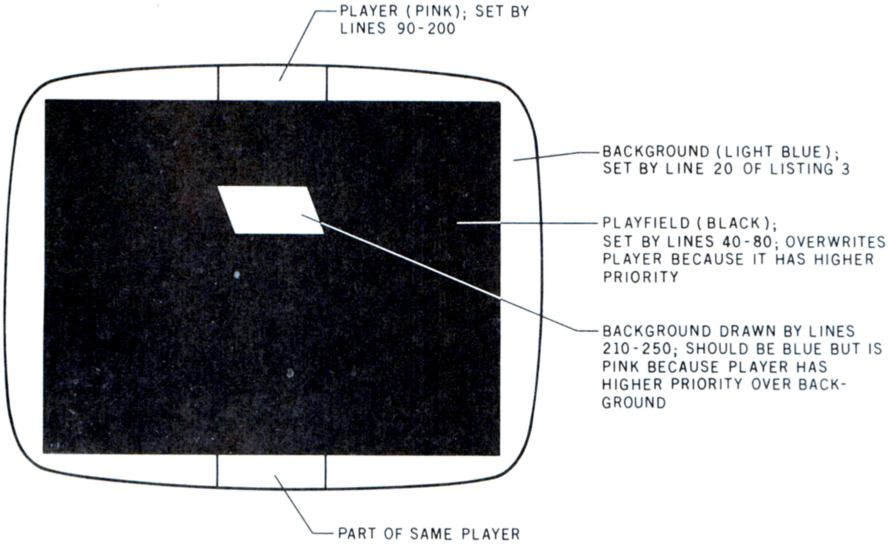
PLAYER (PINK); SET BY LINES 90-200
BACKGROUND (LIGHT BLUE); SET BY LINE 20 OF LISTING 3
PLAYFIELD (BLACK); SET BY LINES 40-80; OVERWRITES PLAYER BECAUSE IT HAS HIGHER PRIORITY
BACKGROUND DRAWN BY LINES 210-250; SHOULD BE BLUE BUT IS PINK BECAUSE PLAYER HAS HIGHER PRIORITY OVER BACKGROUND
PART OF SAME PLAYER

Figure 3: *Playing tricks with the video display to achieve higher player resolution. This technique works by manipulating the relative priorities of the playfield, players, and background. See the text and listing 3 for details.*

Listing 4: *An Atari BASIC program to create a player in the shape of an integral sign. See figure 4.*

```
  1  RAMTOP=106:REM               OS top of RAM pointer
  2  PMBASE=54279:REM             ANTIC player-missile RAM pointer
  3  SDMCTL=559:REM               shadow of DMACTL
  4  GRACTL=53277:REM             CTIA's graphics control register
  5  HPOSP0=53248:REM             horizontal position register of P0
  6  PCOLR0=704:REM               shadow of player 0 color register
 10  GRAPHICS 0:A=PEEK(RAMTOP)-
     16:REM                       must back up for 1-line resolution
 20  POKE PMBASE,A
 30  MYPMBASE=256*A
 40  POKE SDMCTL,62
 50  POKE GRACTL,3
 60  POKE HPOSP0,102
 70  FOR I=MYPMBASE+1024 TO
     MYPMBASE+1280
 80  POKE I,0
 90  NEXT I
100  POKE PCOLR0,140
110  FOR I=0 TO 15
120  READ X
130  POKE MYPMBASE+1100+I,X
140  NEXT I
150  DATA 14,29,24,24,24,24,24,24
160  DATA 24,24,24,24,24,24,184,112
170  ?" ":REM                     clear screen
180  POSITION 15,6
190  ?"x dx"
```

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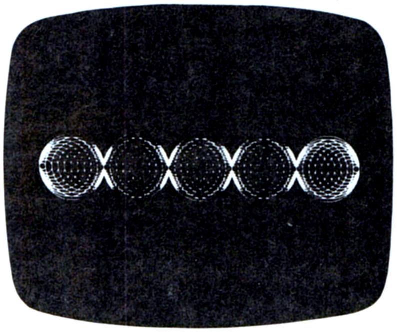

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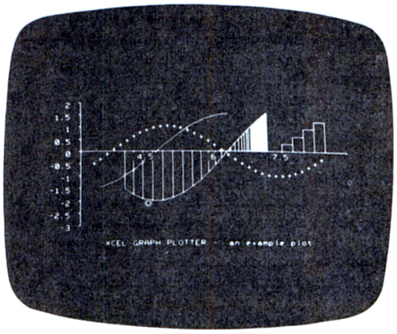

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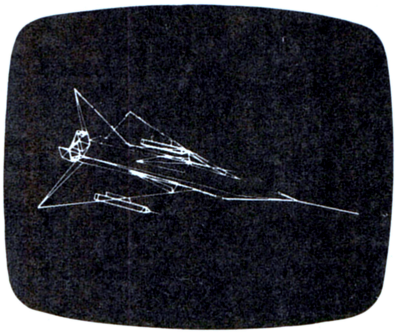

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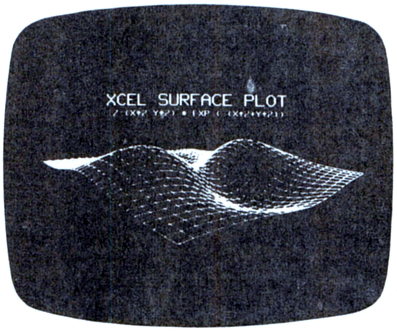

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Appendix A: Selected Hardware Registers in the Atari 400/800

Hardware Register				Shadow Register (if any)		
		Location			Location	
Symbolic Name	Function	Hexadecimal	Decimal	Symbolic Name	Hexadecimal	Decimal
COLBK	Color Luminance of Background	D01A	53274	COLOR4	2C8	712
COLPF0	Color Luminance of Playfield 0	D016	53270	COLOR0	2C4	708
COLPF1	Color Luminance of Playfield 1	D017	53271	COLOR1	2C5	709
COLPF2	Color Luminance of Playfield 2	D018	53272	COLOR2	2C6	710
COLPF3	Color Luminance of Playfield 3	D019	53273	COLOR3	2C7	711
COLPM0	Color Luminance of Player-Missile 0	D012	53266	PCOLR0	2C0	704
COLPM1	Color Luminance of Player-Missile 1	D013	53267	PCOLR1	2C1	705
COLPM2	Color Luminance of Player-Missile 2	D014	53268	PCOLR2	2C2	706
COLPM3	Color Luminance of Player-Missile 3	D015	53269	PCOLR3	2C3	707
DMACTL	Direct Memory Access (DMA) Control	D400	54272	SDMCTL	22F	559
GRACTL	Graphic Control	D01D	53277			
GRAFM	Graphics for all Missiles	D011	53265			
GRAFP0	Graphics for Player 0	D00D	53261			
GRAFP1	Graphics for Player 1	D00E	53262			
GRAFP2	Graphics for Player 2	D00F	53263			
GRAFP3	Graphics for Player 3	D010	53264			
HITCLR	Collision Clear	D01E	53278			
HPOSM0	Horizontal Position of Missile 0	D004	53252			
HPOSM1	Horizontal Position of Missile 1	D005	53253			
HPOSM2	Horizontal Position of Missile 2	D006	53254			
HPOSM3	Horizontal Position of Missile 3	D007	53255			
HPOSP0	Horizontal Position of Player 0	D000	53248			
HPOSP1	Horizontal Position of Player 1	D001	53249			
HPOSP2	Horizontal Position of Player 2	D002	53250			
HPOSP3	Horizontal Position of Player 3	D003	53251			
M0PF	Missile 0 to Playfield Collisions	D000	53248			
M0PL	Missile 0 to Player Collisions	D008	53256			
M1PF	Missile 1 to Playfield Collisions	D001	53249			
M1PL	Missile 1 to Player Collisions	D009	53257			
M2PF	Missile 2 to Playfield Collisions	D002	53250			
M2PL	Missile 2 to Player Collisions	D00A	53258			
M3PF	Missile 3 to Playfield Collisions	D003	53251			
M3PL	Missile 3 to Player Collisions	D00B	53259			
P0PF	Player 0 to Playfield Collisions	D004	53252			
P0PL	Player 0 to Player Collisions	D00C	53260			
P1PF	Player 1 to Playfield Collisions	D005	53253			
P1PL	Player 1 to Player Collisions	D00D	53261			
P2PF	Player 2 to Playfield Collisions	D006	53254			
P2PL	Player 2 to Player Collisions	D00E	53262			
P3PF	Player 3 to Playfield Collisions	D007	53255			
P3PL	Player 3 to Player Collisions	D00F	53263			
PMBASE	Player Missile Base Address	D407	54279			
PRIOR	Priority Select	D01B	53275	GPRIOR	26F	623
SIZEM	Sizes for all Missiles	D00C	53260			
SIZEP0	Size of Player 0	D008	53256			
SIZEP1	Size of Player 1	D009	53257			
SIZEP2	Size of Player 2	D00A	53258			
SIZEP3	Size of Player 3	D00B	53259			

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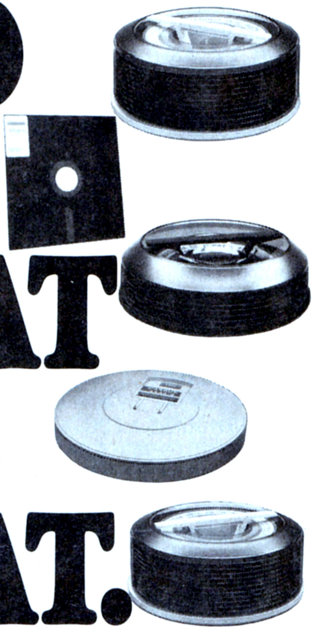
Appendix B: Functional Specification of Selected Atari 400/800 Hardware Registers

The following charts give the functions of the registers listed in Appendix A on a bit-by-bit basis. Although this information is not necessary to the understanding of the article, it is given for the benefit of advanced programmers who want to exercise complete control over the player-missile graphics. This information is excerpted from the *Atari Personal Computer System Operating System User's Manual and Hardware Manual* (part C016555), which contains complete technical information on this and other aspects of the Atari 400 and 800 computers. This user's manual can be purchased from Atari Customer Service, 1346 Bordeaux Dr, Sunnyvale CA 94086; the price is $27 plus $3 shipping and handling (California residents must add 6½% tax).

COLBK (Background Color): This address writes data to the Background Color-Luminance Register.

Color				Luminance				
D7	D6	D5	D4	D3	D2	D1	Not Used	
X	X	X	X	0	0	0		Zero Luminance (black)
	(see below)			0	0	1		
					etc			
				1	1	1		Max. Luminance (white)
0	0	0	0					Grey
0	0	0	1					Gold
0	0	1	0					Orange
0	0	1	1					Red-Orange
0	1	0	0					Pink
0	1	0	1					Purple
0	1	1	0					Purple-Blue
0	1	1	1					Blue
1	0	0	0					Blue
1	0	0	1					Light-Blue
1	0	1	0					Turquoise
1	0	1	1					Green-Blue
1	1	0	0					Green
1	1	0	1					Yellow-Green
1	1	1	0					Orange-Green
1	1	1	1					Light-Orange

Shadow Register: COLOR4



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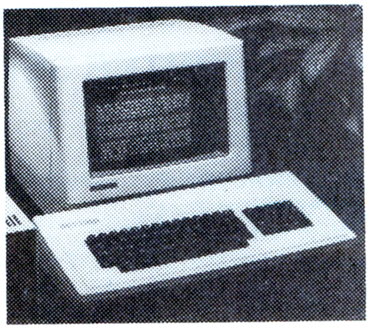

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COLPF0—COLPF3 (Playfield Color): These addresses write data to the Playfield Color-Luminance Registers.

D7	D6	D5	D4	D3	D2	D1	D0

(see COLBK for bit assignment)

Shadow Registers: COLOR0—3

COLPM0—COLPM3 (Player-Missile Color): These addresses write to the Player-Missile Color-Luminance Registers. Missiles have the same color luminance as their player unless missiles are used as a fifth player (see bit 4 of PRIOR). A fifth player missile gets its color from register COLPF3.

D7	D6	D5	D4	D3	D2	D1	D0

(see COLBK for bit assignments)

Shadow Registers: PCOLR0—3

DMACTL (Direct Memory Access Control): This address writes data into the DMA Control Register.

Not Used	D5	D4	D3	D2	D1	D0

D5 = 1 Enable ANTIC operation (must be set to 1)
D4 = 1 1 line Player/Missile resolution
D4 = 0 2 line Player/Missile resolution
D3 = 1 Enable Player DMA
D2 = 1 Enable Missile DMA
D1,D0 = 0 0 No Playfield DMA
= 0 1 Narrow Playfield DMA (128 Color Clocks)
= 1 0 Standard Playfield DMA (160 Color Clocks)
= 1 1 Wide Playfield DMA (192 Color Clocks)

See GRACTL. Shadow Register: SDMCTL, default value hexadecimal 22

GRACTL (Graphics Control): This address writes data to the Graphic Control Register.

Not Used	D1	D0

D1 = 1 Enable Player DMA to Player Graphics Registers.
D0 = 1 Enable Missile DMA to Missile Graphics Registers.

DMA is enabled by setting bits in both DMACTL and GRACTL. Setting DMACTL only will result in cycles being stolen, but no display will be generated.

GRAFM (Missile Graphics Registers): This address writes data directly into the Missile Graphics Register, independent of DMA. This is a bit-map of the current scan line of all four missiles. It is automatically maintained by the normal use of player-missile graphics.

D7	D6	D5	D4	D3	D2	D1	D0	
L	R	L	R	L	R	L	R	
M3		M2		M1		M0		Missile Number

GRAFP0—GRAFP3 (Player Graphics Registers): These addresses write data directly into the Player Graphics Registers, independent of DMA. This is a bit-map of the current scan line for a given player. It is automatically maintained by the normal use of player-missile graphics.

D7	D6	D5	D4	D3	D2	D1	D0
Left							Right

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Not Used

HPOSM0—HPOSM3 (Missile Horizontal Position): These addresses write data into the Missile Horizontal Position Registers (see HPOSP0 description below).

D7	D6	D5	D4	D3	D2	D1	D0

HPOSP0—HPOSP3 (Player Horizontal Position): These addresses write data into the Player Horizontal Position Register. The horizontal position value determines the color clock location of the left edge of the object. Hexadecimal 30 is the left edge of a standard-width screen. Hexadecimal D0 is the right edge of a standard-width screen.

D7	D6	D5	D4	D3	D2	D1	D0

M0PF, M1PF, M2PF, M3PF (Missile-to-Playfield Collisions): These addresses read missile-to-playfield collisions. A 1 bit means that a collision has been detected since the last HITCLR.

Not Used (forced to zero)	D3	D2	D1	D0	
	3	2	1	0	Playfield Type

M0PL, M1PL, M2PL, M3PL (Missile-to-Player Collisions): These addresses read missile-to-player collisions.

Not Used (forced to zero)	D3	D2	D1	D0	
	3	2	1	0	Player Number

P0PF, P1PF, P2PF, P3PF (Player-to-Playfield Collisions): These addresses read player-to-playfield collisions.

Not Used (forced to zero)	D3	D2	D1	D0	
	3	2	1	0	Playfield Type

P0PL, P1PL, P2PL, P3PL (Player-to-Player Collisions): These addresses read player-to-player collisions.

Not Used (forced to zero)	D3	D2	D1	D0	
	3	2	1	0	Player Number

(Player *n* against player *n* is always a zero.)

PMBASE (Player-Missile Address Base Register): This address writes data into the Player-Missile Address Base Register. The data specify the most-significant bits of the address of the beginning of the player-missile area.

One-Line Resolution

D7	D6	D5	D4	D3	not used	PMBASE

Two-Line Resolution

D7	D6	D5	D4	D3	D2	not used	PMBASE

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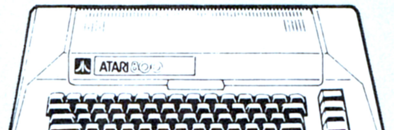

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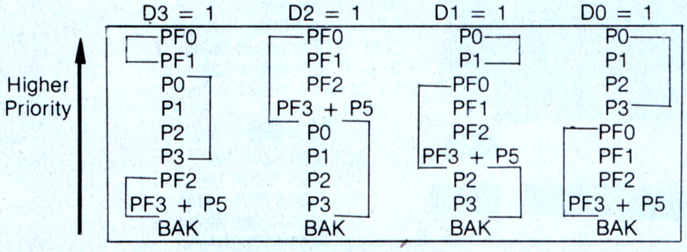
PRIOR (Priority Register): This address writes data into the Priority Control Register.

D7	D6	D5	D4	D3	D2	D1	D0

D7—D6	Set to zero.
D5	*Multiple Color Player Enable* This bit set to 1 causes the logical "or" function of the bits of the colors of Player 0 with Player 1, and also of Player 2 with Player 3. This permits overlapping the position of two players with a choice of three colors in the overlapped region.
D4	*Fifth Player Enable* This bit causes all missiles to assume the color of Playfield Type 3. (COLPF3). This allows missiles to be positioned together with a common color for use as a fifth player.
D3—D0	*Priority Select* Only one of these 4 bits can be a 1. These bits select one of four types of priority. Objects with higher priority will appear to move in front of objects with lower priority.



P*n* = player *n*
PF*n* = playfield *n*
BAK = background
+ = logical *or* (PF3 and P5 are always same color)

Note: The use of priority bits in a "nonexclusive" mode (more than one bit set to 1) will result in objects whose priorities are in conflict turning *black* in the overlap region.

Example: PRIOR code = 1010: This will black out P0 or P1 if they are over PF0 or PF1. It will also black out P2 or P3 if they are over PF2 or PF3. In the one-color 40-character (playfield) modes, the *luminance* of a pixel in a character is determined by COLPF1, regardless of the priority. If a higher-priority player or missile overlaps the character, the *color* is determined by the player's color.

Shadow Register: GPRIOR

SIZEM (Missile Size): This address writes data into the Missile Size Control Register.

Horizontal Size
Register (Missile)

D7	D6	D5	D4	D3	D2	D1	D0
M3		M2		M1		M0	

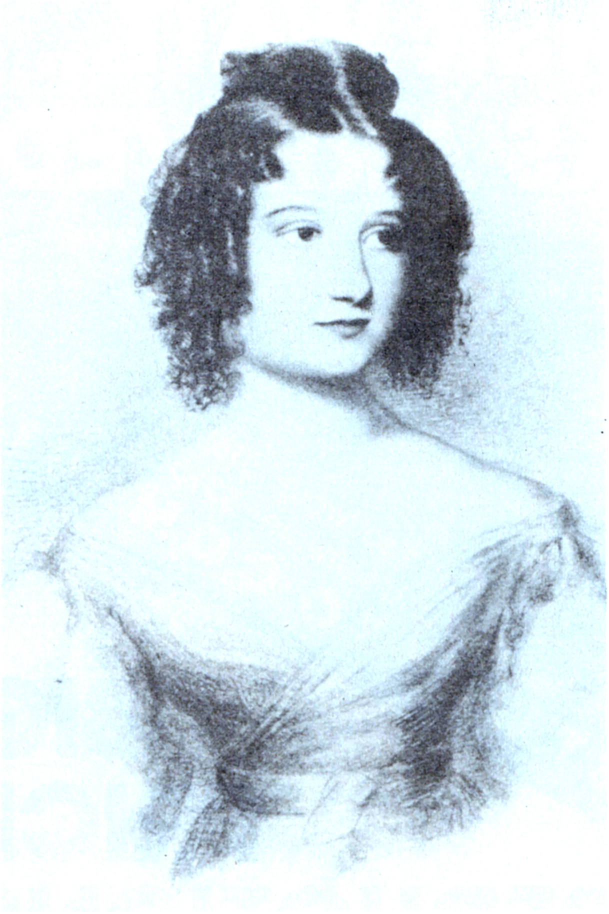
D1	D0	
0	0	Normal Size (total of 2 color clocks wide)
0	1	Twice Normal Size (total of 4 color clocks wide)
1	0	Normal Size
1	1	Four Times Normal Size (total of 8 color clocks wide)

SIZEP0—SIZEP3 (Player Size): These addresses write data into the Player Size Control Registers.

Horizontal Size
Register (Player)

Not Used	D1	D0	
	0	0	Normal Size (total of 8 color clocks wide)
	0	1	Twice Normal Size (total of 16 color clocks wide)
	1	0	Normal Size
	1	1	Four Times Normal Size (total of 32 color clocks wide)

With normal-size objects, each bit in the graphics register corresponds to one color clock. This makes an 8-bit wide player 8 color clocks wide. For larger objects, each bit is extended over more than one color clock.



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ENHBAS

Mahlon G Kelly
268 Turkey Ridge Rd
Charlottesville VA 22901

Whatever its merits or demerits, BASIC is the language most used by microcomputer programmers. Microsoft's excellent implementation of BASIC is one of the reasons the TRS-80 Model I is the most popular microcomputer today. Most of us note the absence of some particular feature (I would like to have matrix functions), but everyone's needs are different. I was, therefore, skeptical about the usefulness of an enhancement package for TRS-80 BASIC.

I am no longer a skeptic. ENHBAS (pronounced *en-base*), written by Philip A Oliver and sold by the Cornsoft Group, provides useful new functions, statements, and commands, and greatly improves the operating environment by providing keyboard, video, and audio enhancements. This software is designed for the TRS-80: it is not rewarmed and reworked from some other system. And ENHBAS makes programming much more enjoyable. In terms of packaging, documentation, ease of use, lack of bugs, and overall quality of design, ENHBAS is the best software package I have seen for the TRS-80, and that *includes* Microsoft's BASIC compiler, NEWDOS/80, VTOS, and Scripsit. With the release of this product, a small company and a single author have entered the big league in quality software.

ENHBAS resides in about 4 K bytes of RAM. It provides new keyboard, printer, and video drivers and a variety of new commands, statements, and functions. The drivers give a user-definable cursor, clicks when keys are pressed, true control characters, distinctive tones for error and break, single-key entry for such things as PRINT and INPUT, a lowercase driver, and a variety of other features. The printer driver even senses whether or not a printer is on line, waits six seconds for the printer to be turned on, and if it isn't, gives an error message and returns without "hanging" the system. If a BASIC program is NEWed or even if the system is booted, simply typing RENEW after bringing BASIC back up will usually restore the program. That means no more program loss after accidental reboots. The new statements are described below in detail, and they include new graphics, branching, screen control, sorting, printer formatting, and more.

Two smaller versions, ENHSORT and ENHGRAPH, are also available at $24.95 each. They support ENHBAS sorting routines and graphics routines, respectively. Programs written for these versions are upward compatible with ENHBAS.

ENHBAS is available for Models I, II, and III. The Model III package is nearly identical to that for the Model I, and there are disk and tape versions for both. The tape version provides all of the functions of disk BASIC except file manipulation functions and multiple USR routines. There are also many additional enhancements for the Model II, but since I used the disk-based Model I system, I'll only mention a few of those features.

Initialization and Loading

The disk version of ENHBAS comes on a special disk that is copy-protected and has its own tiny operating system. You put the disk in drive 0 and boot the system. After a prompt, you place a TRSDOS or NEWDOS 2.1 disk in the drive, and a 32 K or 48 K version of ENHBAS/CMD is dumped to that system disk.

At a Glance

Name
ENHBAS

Type
Enhanced operating environment and BASIC language

Manufacturer
The Cornsoft Group
6008 N Keystone Ave
Indianapolis IN 46220
(317) 257-3227

Price
$59.95 (Model I or III), $99.95 (Model II)

Format
Tape, 5- or 8-inch disk depending on computer

Computer
TRS-80 Model I (tape or disk), Model II, or Model III

Documentation
Three-ring binder with 55 pages of text

Audience
Any TRS-80 user

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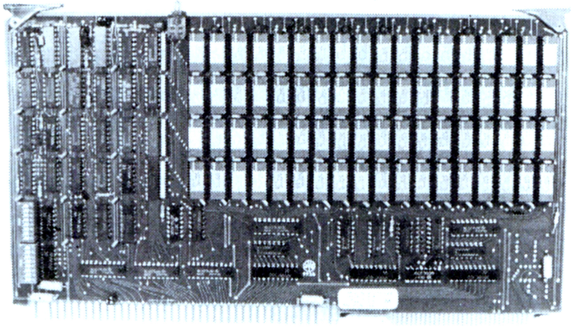

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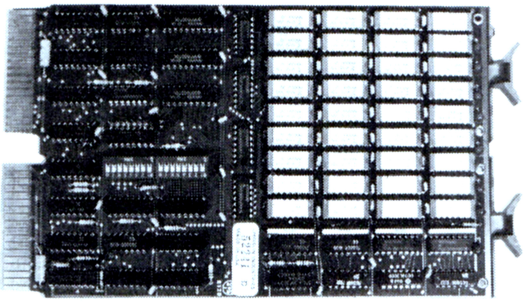

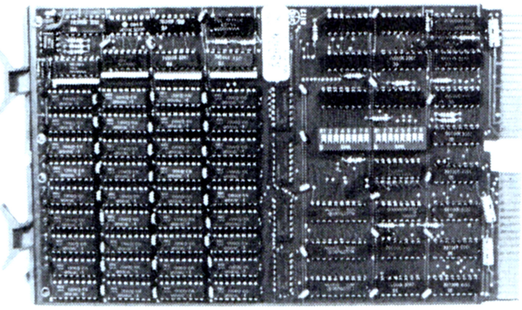

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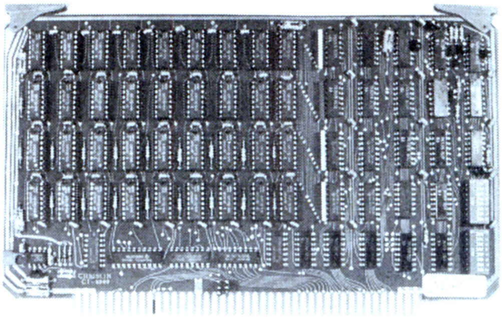

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The initialization software automatically senses the size of the system. For use with NEWDOS/80, the program must be copied from the NEWDOS 2.1 or TRSDOS disk. The author has assured me that the software is compatible with all currently available operating systems that use the TRSDOS disk format. In all, the original initialization takes about three minutes, and the original disk is needed again only if the ENHBAS/CMD program is somehow lost.

Use of the new program is just as simple. Typing ENHBAS <ENTER> loads and initializes the package, protects a section of upper RAM (random-access read/write memory), and brings up BASIC. The memory size, file number, and program loading and running conventions are the same as before for the operating system being used, but they follow the ENHBAS command instead of BASIC. A return to command level leaves the new drivers intact. All the appropriate features are available in DOS (disk operating system) mode or during use of any /CMD program that doesn't have its own drivers (sadly, Scripsit does). The only incompatible programs I have found are the DSET and DBLFMT commands in Software Etc's implementation of double density for NEWDOS/80, but these present trivial problems that are easily circumvented. BASIC can be reentered just as before.

Typing ENHBAS again will lock up the system, which was one of the few faults that I found; it would be nice to be able to disable ENHBAS without rebooting. Since you will almost always want ENHBAS in the system, it's most easily initialized by a CHAIN command if your operating system has such a feature. Listing 1 shows a NEWDOS/80 double-density chain file that does the initialization and reenters DOS. A file for use with ComProc or other DOSes would be similar. The tape system is initialized by typing SYSTEM; typing ENHBAS after the prompt then loads and initializes the tape.

Listing 1: *A CHAIN file for use with NEWDOS/80 and the Percom Doubler to load and initialize ENHBAS. ADR disables and enables automatic recognition of double density. The POKE at line 40 enables control-H to sound the bell; the POKE at line 50 changes the cursor character. PAGE and CLM set page length and number of characters per line. Removal of ADR allows it to be used with NEWDOS/80 version 2.0.*

```
10     OPEN"O",1,"ENHBAS/JCL"      'OPEN THE CHAIN FILE
20     PRINT #1, "ADR OFF"        'AUTO DENSITY RECOGNITION OFF
30     PRINT #1, "ENHBAS"          'INITIALIZE
40     PRINT #1, " POKE 16409,1"    'ENABLE THE BELL
50     PRINT #1, " POKE 16419,127"  'CHANGE THE CURSOR
60     PRINT #1, " PAGE=55"         'PAGE LENGTH
70     PRINT #1, " CLM=132"         'COLUMN WIDTH
80     PRINT #1, " CMD";CHR$(34);"S";CHR$(34) 'RETURN TO DOS
90     PRINT #1, "ADR ON"          'AUTO DENSITY RECOGNITION ON
100    CLOSE
```

ENHBAS

The TRS-80™ Programmer's Language

reviewed this month by Mahlon Kelly is available through the following dealers & distributors, who carry the complete line of products from **THE CORNSOFT GROUP.** Specify Model I/III disk, Model I/III cassette or Model II disk.

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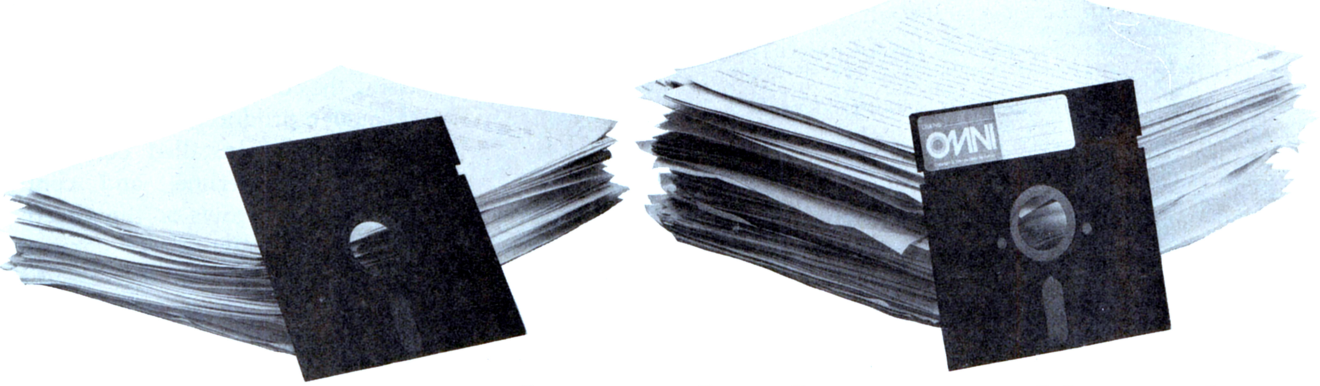

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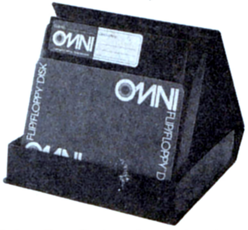

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Listing 2: *ENHBAS's sort functions in action. The program in listing 2a, which produces the output in listing 2b, displays four arrays five times each. First they appear unsorted, then sorted according to the different keys and tags noted in the program's remarks.*

(2a)

```
10     CLEAR 200:DEFINT A-Z
20     DIM A(20),B$(20),C(20),D$(20)
30     LPRINT "A(X)","B$(X)","C(X)","D$(X)" 'PRINT HEADERS
40     LPRINT STRING$ (55,"#")
50     FOR I=1 TO 5 'SET UP ARRAYS AS RANDOM NUMBERS AND LETTERS
60     A(I)=RND(5): B$(I)=CHR$(70+RND(5)): C(I)=RND(999): D$(I)=CHR$(80+RND(10)
70     NEXT I
80     GSUB "PNT" 'PRINT THE ORIGINAL RANDOM ARRAYS
90     SCLEAR ' CLEAR FOR THE SORT
100    KEY A ' SORT ON INTEGER ARRAY A, ASCENDING
110    ATOP=5 ' USE ONLY THE FIRST FIVE ELEMENTS
120    SORT ' DO THE SORT!
130    GSUB "PNT" ' PRINT THE RESULTS
140    SCLEAR ' CLEAR FOR THE NEXT SORT
150    ATOP=5 ' FIRST FIVE ELEMENTS ONLY
160    KEY C ' SORT ON INTEGER ARRAY "C"
170    TAG A ' FORCE THE ELEMENTS OF ARRAY "A" TO FOLLOW "C"
180    SORT ' DO THE SORT.
190    GSUB "PNT" ' PRINT THE RESULTS
200    SCLEAR ' SET UP FOR THE NEXT SORT
210    ATOP=5 ' FIRST 5 ELEMENTS ONLY
220    KEY C,B$ ' PRIORITY SORT ON B$, NEXT ON ARRAY C(X)
230    TAG A,D$ ' FORCE ARRAYS A AND D$ TO FOLLOW C AND B$
240    SORT ' SORT THEM
250    GSUB "PNT" ' PRINT THE SORT RESULTS
260    SORT (1) ' DO A DESCENDING SORT
270    GSUB "PNT" ' PRINT THE RESULT
280    LPRINT CHR$(12)
290    END
500    JNAME "PNT"' PRINTING SUBROUTINE
510    FOR I=1 TO 5
520    LPRINT A(I),B$(I),C(I),D$(I)
530    NEXT I
540    LPRINT STRING$ (55,"#")
550    RETURN
```

(2b)

```
A(X)            B$(X)           C(X)            D$(X)
#######################################################
 1              G                577            S
 5              J                649            R
 3              I                874            Y
 5              K                972            V
 1              J                429            W
#######################################################
 1              G                577            S
 1              J                649            R
 3              I                874            Y
 5              K                972            V
 5              J                429            W
#######################################################
 5              G                429            S
 1              J                577            R
 1              I                649            Y
 3              K                874            V
 5              J                972            W
#######################################################
 5              G                429            S
 1              I                649            Y
 1              J                577            R
 5              J                972            W
 3              K                874            V
#######################################################
 3              K                874            V
 5              J                972            W
 1              J                577            R
 1              I                649            Y
 5              G                429            S
#######################################################
```

The Operating Environment

The first thing you notice after initialization is that the cursor is now a block (this can be changed to any character by a single POKE, which is handy for letting the cursor tell you where you are in a complex program). If an amplifier is connected to the tape output, pressing a key will produce a "click" (really a very short beep). This gives a professional feel to the keyboard and it's a nice feature for those of us who are touch typists; it's something I have longed for in Scripsit. Pressing BREAK produces a different tone, and an error produces a two-tone signal. If PRINT CHRS$(8) (ASCII bell) is in a program, Westminster chimes sound!

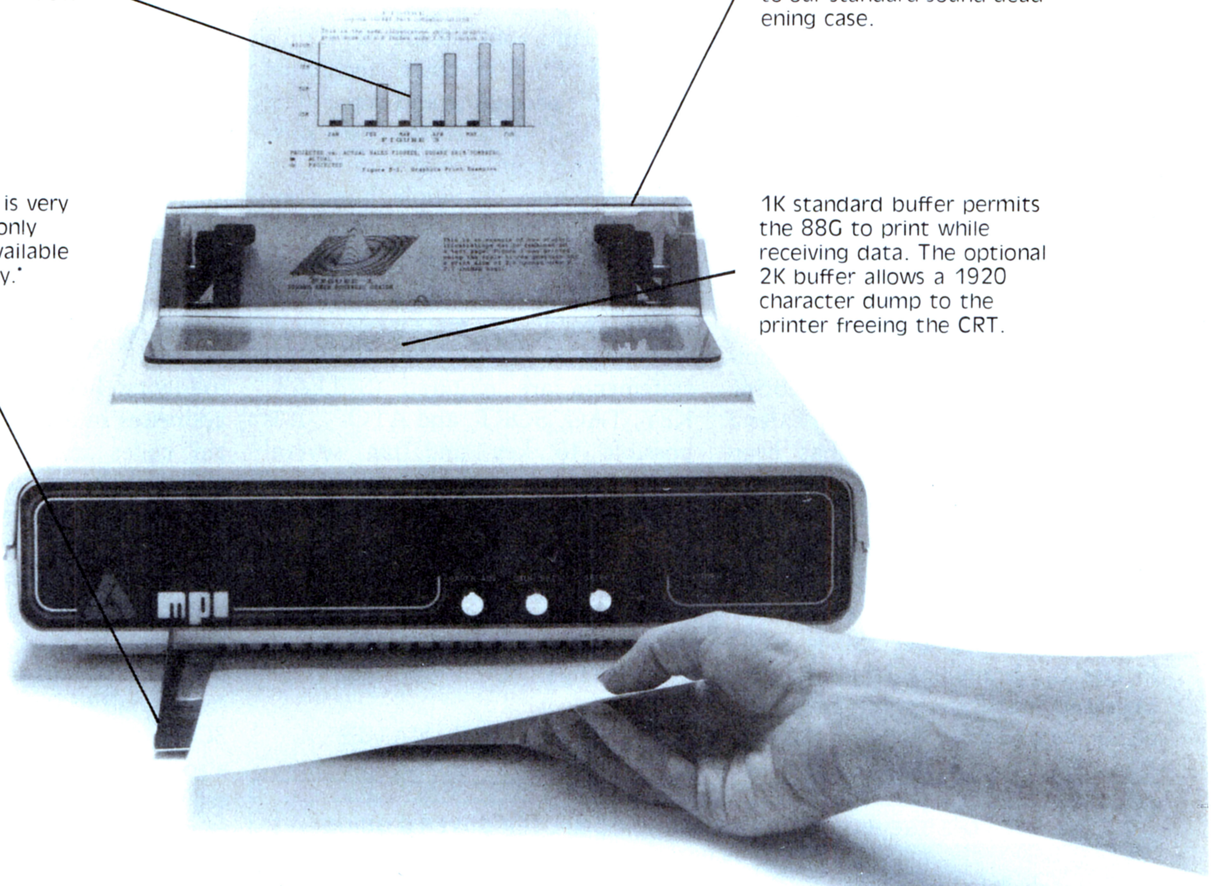
The CLEAR key is redefined as a true control (sometimes abbreviated as *ctrl*) key. You clear the screen by using control-@. Most of the control characters do nothing in the normal TRS-80, but control-H produces a backspace, control-G sounds Westminster chimes, control-C is a break (with an echo of a down-arrow and C to the screen, which BREAK also does), control-A is a break without echo, control-I is a tab, and control-J is a linefeed with carriage return. Using the control key with numerals 1 through 6 produces special characters if lowercase is installed, control-dash gives an underline, and control-arrows puts arrows on the screen.

Four one-letter direct commands are available (similar to NEWDOS). E, R, L, and D produce EDIT, RUN, LIST, and DELETE, respectively. Similarly, single-key abbreviations are available for 35 different BASIC commands, statements, and functions by simultaneously pressing the shift key, the clear key, and the abbreviation key. Shift-clear and A produces AUTO, shift-clear and P produces PRINT, shift-clear and N produces NEXT, shift-clear and D produces DIM, and so on. I find this of little value except with the most commonly used words; otherwise it's quicker to type the word than to look it up, even if the keys are labeled. But some people may find more of these single-key abbreviations useful.

Another nice feature is formatting of program listings. The printer driver indents text by six spaces as shown in listing 2; this makes listings easier to read, and the feature works for video output as well. I've already mentioned the user-definable cursor and the ability to sense whether or not the printer is available. These enhancements of the operating environment seem to me practically worth the cost of the entire package. But they are only a minor part of ENHBAS. The main features are the enhancements to the BASIC language itself.

Language Enhancements

Programming enhancements can be divided into commands, statements, and functions. In all, 33 have been added to the language (as compared to about 85 originally available in the Microsoft Level II BASIC and about 40 added by TRSDOS), although sev-



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eral are interrelated. We'll look at the added commands and functions one by one. Most of the statements can be divided among those that control sorting, branching, graphics, screen displays, and printer formatting.

There are two new commands: RENEW and FIND. RENEW, which has already been described, is one of the most useful of ENHBAS's features, since it almost always allows recovery of a BASIC program unless there has been an attempt to overlay the BASIC memory area or a loss of power. It's even possible to leave BASIC, execute DOS commands, then reenter BASIC and bring the old program back. FIND locates a part of a program that has been labeled using the JNAME statement (described with the new branching statements below). FIND makes it possible to label a line with a name and then branch to the name rather than the line number. Since FIND locates the branching label, subroutines and branching points may each be named and easily located. All who have suffered with improperly commented subroutines will appreciate this feature.

Sorting

The sorting routines are based on a modified Shell-Metzner technique and handle ascending and descending numeric and string sorts. These sorting routines were the inspiration for ENHBAS, since the whole thing grew out of the development of a machine-language sorting project. The sort routines are easy to set up (at least if you're used to machine-language sorts such as Racet's GSF). Only five statements are required (SCLEAR, KEY, TAG, SORT, and ATOP). It is possible to key and tag several arrays. A sort should usually be preceded by the statement SCLEAR (really a function), and then the variables to be sorted are set up using KEY (the variables may be alphabetic or numeric and are stored in an array). Thus:

```
120 KEY AGE, NAME$
```

would set up a sort in line 120 so that a string array NAME$(x) would be sorted with top priority, and if there were duplicate entries they would be sorted by order using the numeric array AGE(x). Using KEY, you can set sorting priorities for up to fourteen different arrays. You usually want a sort to carry along another variable with the sorted elements, and TAG allows that. Thus a sort by names could carry addresses along with the names. For example:

```
130 TAG ADDR$, ZIP
```

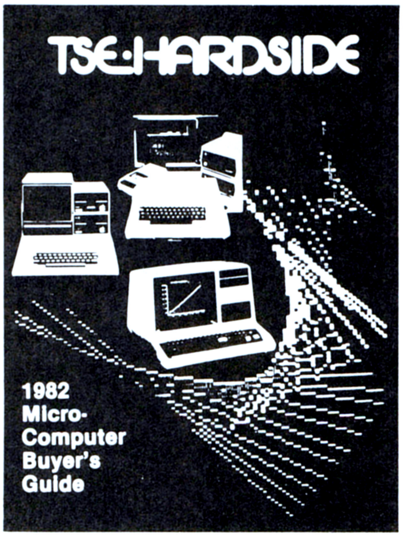
following line 120 would force the addresses in array ADDR(x) and the zip codes in array ZIP(x) to tag along after the names and ages as they were sorted by the KEY specification in line 120. Up to fourteen arrays can tag along in the sort. The statement SORT (f) actually forces the sort. The "f" is a flag that specifies if the sort should arrange the elements from small to large or large to small. SORT (0) (or simply SORT) produces a sort in ascending order, from smallest to largest. SORT (1) does a descending sort, with the largest elements coming first. A sort will actually process all the elements dimensioned in an array, whether they have been assigned values or not (the arrays must be of equal length). When you don't need all the elements in an array, you can specify the upper limit. If we added

```
140 ATOP=(12)
```

to the previous statements, this statement would limit the sort to the first twelve array elements. The short program in listing 2 illustrates the sort procedure and its output. The sorts are very fast: 500 integers can be sorted in less than four seconds.

Branching

ENHBAS provides three new types of branching options. These are branching to labels and variables, selective restoring of DATA statements (that is, the data pointer can be restored to something other than the initial data element), and conditional looping using the WHILE/



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WEND construct. The labeled branching enhancement uses the statements JNAME, GTO, and CSUB. JNAME places a label in a line. In listing 2, for example, the JNAME "pnt" labels the subroutine "pnt". JNAME must be the first statement in a line, and it cannot be followed by REM without a colon first; an apostrophe (') may be used, but there must never be a space after the label (despite an example to the contrary in the documentation). Labeled subroutines make programs much more readable and, of course, avoid the possibility of incorrect branching caused by changing the number of a subroutine's first line. Branching to labels also enables you to move subroutines around without worrying about losing track of them in the calling statements.

The use of labeled subroutines requires two new calling statements. GTO and CSUB (for call subroutine) are used exactly like GOTO and GOSUB except that they call a routine labeled in a JNAME statement. GTO and CSUB can also call a line number defined by variable. For example, GTO X*100 with a value for X of 5 would force a branch to line 500. This allows conditional branching according to whether a condition is "true" or "false." The FIND command, mentioned above, lets you locate a line previously labeled using JNAME by simply typing FIND (name); FIND "PNT" would locate that subroutine in listing 2, although FIND would normally be used with much more complex programs.

The WHILE and WEND statements go a long way toward making BASIC a structured language. They are used in the same way WHILE and WEND are used in more extended Microsoft BASICs, such as the BASIC compiler for the TRS-80. WHILE a condition is "true," WEND placed at the end of a loop will send execution back to the WHILE statement. Thus the short program:

```
10 X=0
20 WHILE X< =8;
30 PRINT X
40 X=X+1
50 WEND
```

will have the same effect as:

```
10 FOR X=1 TO 8
20 PRINT X
30 NEXT X
```

Although the former program is longer, in a less trivial example it forces much better programming practice and a more logical program flow. Conditional loops of this sort are one of the reasons many consider Pascal a superior programming language. Note that a semicolon is needed at the end of the WHILE statement; this contrasts with the WHILE construct used by Microsoft.

RDGOTO and RDGTO both do the same thing, except that the latter statement uses the label and variable conventions of CSUB and GTO. In "normal" BASIC, the command RESTORE after reading from DATA statements sends the read pointer back to the first data element. RDGOTO sends it back to a particular line number, so that material may be read from the middle of a data list. RDGTO lets the line be specified by a variable (see the example for GTO given above). I don't

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often use DATA statements, so I can't get excited about this, but I can see that it would be useful in some applications.

Graphics

The new graphics statements are both fun and useful. Although there are only three, PLOT, DRAW, and INVERT, they do a lot. The simplest, INVERT, is really a command. It simply changes each graphics point from on to off, producing a black-on-white effect. Graphics blocks occupied by characters are unaffected.

PLOT is useful for data output. Recall that any graphics point on the screen can be referenced by x and y coordinates. For example, SET(22,33) turns on a point at the x coordinate 22 and the y coordinate 33. PLOT has the construct:

PLOT (flag),x1,y1 TO x2,y2

Thus,

PLOT S,22,33 to 55,44

(which uses the S flag to set points to white) would draw a line between points 22,33 and 55,44. Using the flag R resets the points to black (ie: it "turns off the lights" along a line). PLOT can also be used to draw a rectangle on the screen if the flag is set as SB (set box). Thus,

PLOT SB, 10,10 TO 30,30

would draw a box with its upper left corner at 10,10 and its lower right corner at 30,30. The flag RB is similar, except it turns off the graphics points. Here's a simple exercise. Can you figure out what

CLS: INVERT:PLOT RB,10,10
TO 30,30

would do? (Hint: It would produce a "black on white" figure.)

CLS: PLOT SB,10,10 TO 30,30:
INVERT

would do the same thing.

DRAW is more complex, but basically it allows vector graphics on the TRS-80 screen. Vector graphics can be likened to drawing a line with a pencil that moves in short increments. A previously filled array specifies the direction and the number of increments the pencil should move each time it moves. [*This is similar to* shape tables *used to draw graphic shapes on the Apple II....* **GW**] The structure of the statement is:

DRAW (flag), @ x,y USING
(vector array)

The flags are S or R, with the same meaning as for PLOT, and x and y are the starting point of the line to be drawn. Thus,

DRAW S, @ 30,30 USING A

Listing 3: *A vector-graphics program using ENHBAS's DRAW and PLOT statements. The additional ENHBAS command INVERT is used to achieve a black-on-white effect. (The output of this program is shown in photo 1.)*

```
10    DEFINT A-Z
20    DIM A(25)
30    POKE 16426,1                  'SET THE PLOT SCALE
40    POKE 16427,2                  'SET THE PLOT ROTATION
50    FOR J=1 TO 3                  'FILL AN INDEX ARRAY
60      FOR I=0 TO 7                'TO SPECIFY THE PLOT
70        A=256*J+I+1               '        "
80        IF I=7 THEN A=A+256       '        "
90        A((J-1)*8+I)=A            '        "
100     NEXT I                      '        "
110   NEXT J                        '        "
120   A(22)=0                       '        "
130   CLS
140   FOR X=1 TO 8                  'ROTATE THRU 8 TURNS
150     FOR Y=0 TO 2                'AND DO 3 DIFFERENT PLOTS
160       POKE 16426,X              'THIS DOES THE ROTATE
170       DRAW SET @ 23+40*Y,23 USING A 'THIS DRAWS THE FIG.
180     NEXT Y
190   NEXT X
200   PLOT SB,  3,2 TO 124,45  'THIS DRAWS A BOX AROUND THE FIG
210   INVERT                   'AND THIS MAKES IT BLACK ON WHITE
220   PRINT CHR$(7);           'THIS PLAYS A WESTMINSTER CHIMES
230   GOTO 230
```

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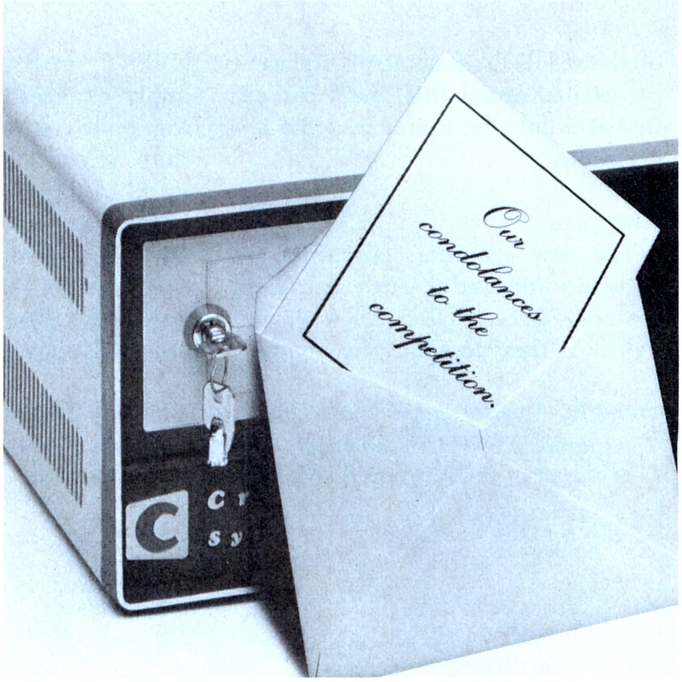

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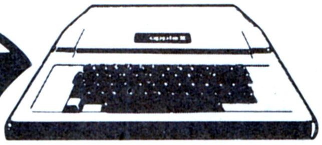

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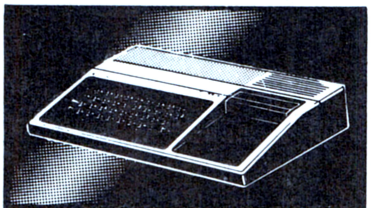

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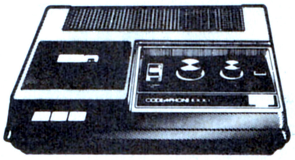

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would produce a complicated line starting at the point 30,30 and using the directions and lengths specified in the array "A". The complications occur in setting up the array. Listing 3 is a short vector-graphics program; photo 1 shows its results. The length of the increments (which specifies the scale of the drawing) and the rotation of the drawing can also be controlled by poking values into two locations in memory (see listing 3). One limitation of the vector graphics used here is that the direction of movement of the "pencil" can be specified only in 45-degree increments.

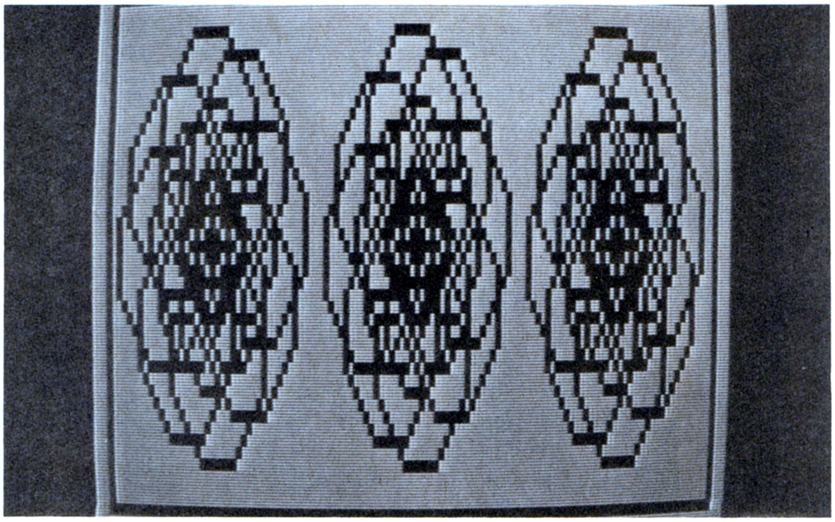

Photo 1: *The output from the simple vector-graphics program given in listing 3. ENHBAS's DRAW, PLOT, and INVERT statements make it easy to program these graphics.*

Screen Control

The first of the screen-control statements, LEFT, is really a command and is most useful in graphics. Its action is simple: it moves everything on the screen one character to the left. This is useful for moving graphs. For example, a sine wave might be drawn onto the screen using SET, and if LEFT were used each time a SET was done the sine wave would travel across the screen. Moving bar graphs and fancy moving graphics are also possible, especially if you combine LEFT with DRAW.

SCROLL produces professional-looking output: it splits the screen into two sections, protecting the upper section from scrolling while allowing the lower to scroll in the usual way. SCROLL is enabled by the statement SCROLL=SET, which also clears the screen. SCROLL=4, for example, then prevents the upper four lines from scrolling; they will stay in place during a listing or output from a program. SCROLL=RESET disables the scroll-protect feature. I like to use this feature when modifying programs by using it in the command mode. I can "lock" a few program lines on the upper screen and use the lower for modifications and listings. Simply typing SCROLL=RESET then brings me back to the normal mode. The screen-clearing feature can be annoying; I would prefer to be able to control clearing separately by using CLS.

Printer Formatting

The two printer-formatting statements are simple but valuable. CLM (integer) sets the maximum column width (in characters) before a wraparound. This is necessary on printers that truncate the end of a line, and useful on others. I use a 14½-inch-wide printer format, and CLM lets me specify that the output would be narrower, thus allowing narrower paper for some applications. The default column width is 80 characters, which surprised me when I first listed a program with long lines.

The command PAGE (number) specifies the number of lines that will be printed on each page. When the

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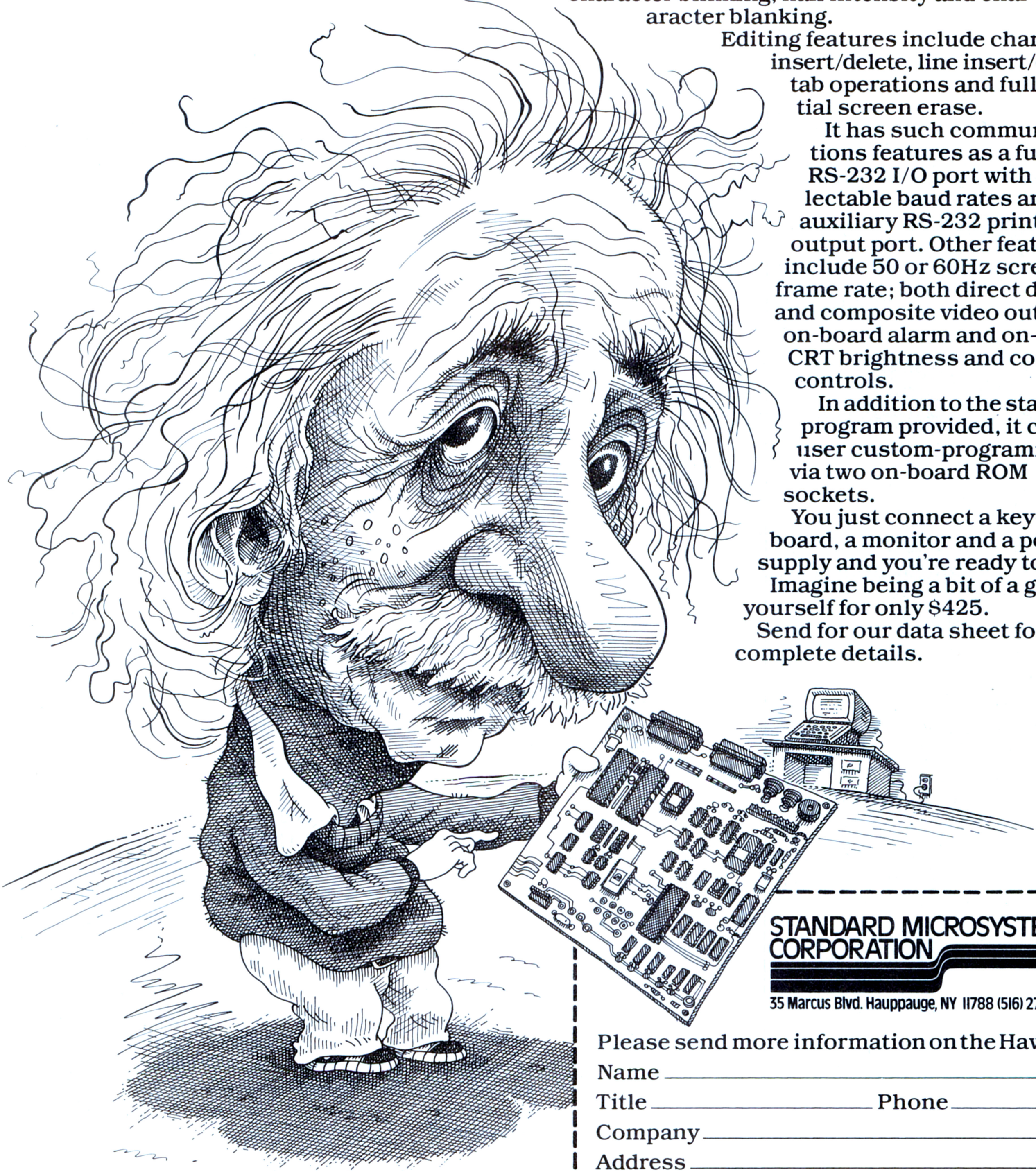

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lines have been printed, the TRS-80 sends blank lines until the top of the next page is reached. Each page is assumed to have a total of 66 lines, printed and blank; if your printer has a different page length, you can change the default by POKEing the correct number in location 16424. Immediately after turning on the computer, I normally set PAGE (at 55) and CLM (at 132) by using a CHAIN file in NEWDOS/80 (see listing 1).

Other Features

ENHBAS has many other useful statements and related functions. By far the most powerful of these is EXEC (string), which executes a string as a program statement. For example:

```
A$="Y=X+2*SIN(X)":EXEC A$
```

executes the statement Y=X+2*SIN(X). Using EXEC, you can define statements as strings and repeatedly execute the statements in the program. This can eliminate a lot of GOSUB s to short subroutines. You can also construct statements using string manipulation and then execute them. In theory it is even possible to write a BASIC program that will write another program.

A similar routine is EVAL, although it is really a function rather than a statement. The statement

```
EVAL (string)
```

evaluates a string as if it is an algebraic expression. Thus:

```
A$="X+2*SIN(X)":Y=EVAL(A$)
```

does the same thing as the example in the previous paragraph. As with EXEC, you can have the program manipulate the strings. As an example of an application for teaching programs, a student can enter a function as a string, and that function could then be evaluated, plotted, etc. I have by no means explored all of the uses of EVAL and EXEC, but they seem to offer a host of possibilities in instructional programs and even a variety of artificial intelligence.

Another miscellaneous statement is POP. POP allows a graceful exit from a subroutine before its end is reached. Suppose a subroutine at line 200 calls another at line 400. A normal branch out of the second subroutine would mean that the next RETURN would bring the program to the point where the second was called in the first subroutine. If POP has been executed, however, the "return to 200" would be eliminated and execution would be returned to the main program. This is similar to the EXIT command in some other BASICs. Usually POP is used with some kind of IF statement or other conditional branch.

WPOKE and WPEEK place and retrieve 16-bit integer values to and from memory. For example, WPOKE (28560), 2992 pokes the integer value 2992 into location 28560 and 28561 (2 bytes are needed to store an integer). WPEEK (28560) then retrieves the number. PRINT WPEEK (16561) returns the memory size that had been set on entering BASIC, for example. WPEEK can be particularly useful in conjunction with VARPTR.

The simplest of the new functions (including WPEEK and EVAL, which have already been described) are PI and EN. PI simply returns the value of π, and EN the value of the exponential constant e (the base of natural or Napierian logarithms). Either single or double precision is returned, depending on the precision of the assignment variable. A!=PI would set A! to 3.14159, while A#=PI would give A# the value of 3.141592653589793.

BIN$ and HEX$ return a string that expresses the binary or hexadecimal value of an integer. A$=BIN$(10432) assigns "0010100011000000" to A$; A$=HEX$(10432) assigns "28C0". I wondered why such functions weren't included in disk BASIC. Now I wonder why a function OCT$ wasn't included in ENHBAS.

SIZE is the simplest function or statement in this whole package. It returns the length (in bytes) of the resident program, in the same way that MEM returns the remaining memory; three years ago I thought a similar function should have been a part of Level I BASIC.

WINKEY$ is another function that should have been a part of an earlier version of the TRS-80 BASICs. Although similar to INKEY$ in that it takes a value from the keyboard without waiting for ENTER to be pressed, WINKEY$ waits until there is an input. While INKEY$ must be put into a sometimes complex loop structure, WINKEY$ can stand alone. This results in code that is shorter and easier to read and allows some input structures that were, previously, nearly impossible. BASIC is probably the consumate interactive language, and WINKEY$ is a function that makes interaction even easier.

PLAY (string) sends a sequence of tones to the cassette port. The first byte of the string specifies the tone and the second and third the duration; this sequence is repeated, 3 bytes at a time, to specify a tune. While it is possible to write simple melodies this way, it isn't easy. The tones are not linear functions of the byte values, and the actual duration depends not only on the two duration bytes but also on the tone value. Thus, writing a tune is a trial-and-error procedure. The command is useful for producing audible prompts in a program, and by using short durations and variable tone values, you can achieve such noise effects as "raspberries," ricochets, and rocket blasts.

CALL should also have been a part of Level II or of disk BASIC. CALL does the same thing as a USR function but in a different way. USR(x) calls a machine-language routine whose entry location has been specified in a DEFUSR statement: CALL does this, but directly. CALL 22856, 56 puts the value 56 into the HL register pair and begins executing a machine-language routine at location 22856. Although this function is simple to use, it must have been difficult to incorporate into ENHBAS.

ENHBAS on Other Systems

I have used only the Model I disk and tape versions of ENHBAS. The tape version provides all of the enhancements mentioned above plus the disk-BASIC enhancements (except those used for disk control and the multiple USR calls, and CALL eliminates the need for the latter). The tape version is entered by using the SYSTEM command. Cornsoft has assured me that the only difference in the Model III version is that it did not at first support the printer-formatting options. By the time you read this, that problem should be corrected.

The Model II version of ENHBAS is superior to the Model I or III, largely because of the way the Model II handles interpreted BASIC. The Model II version includes some functions (like POKE and PEEK) that should have been included with the original system, as well as all the enhancements that are available for the Model I and III and a variety of others. The complete command set for the Model II version of ENHBAS is summarized in table 1 (taken from Cornsoft's advertising literature).

An Overview of ENHBAS

ENHBAS is outstanding software. Good software without support, however, isn't worth much. Support includes documentation, advice from the vendor, updates and modifications, and simple things like delivery and packaging. With ENHBAS, these are as outstanding as the software itself. For $5, and the return of your original ENHBAS disk, Cornsoft will provide updates.

Command	Meaning
DIR	Display disk directory
FIND	List line with specified label
TAG	Mark array to tag along at sort time
SCLEAR	Initialize SORT command
ATOP	Set top limit for SORT
JNAME	Identifies a label for use by GTO and CSUB
GTO	Special GOTO, allows labeled and calculated GOTOs
CSUB	Similar to GTO except accomplishes a GOSUB
RDGOTO	RESTOREs at specified line number
RDGTO	RESTOREs at specified label
WHILE/WEND	Structured loop construct (WHILE cond;: code: WEND)
INSERT	Moves entire file up by n records at specified point
OVERWRITE	Deletes n records in file starting at specified point
TSET	With INDEX FILE, specifies master file record as USED
TRESET	With INDEX FILE, specifies master file record as FREE
CURSOR	Allows changing of system cursor
EXEC	Executes a string expression as a program statement
ON BREAK GOTO	Branch to line number when the BREAK key is hit
BRL	Line at which BREAK was hit when branched to ON BREAK ...
OUTPUT	Acts as PRINT when exp = 0, LPRINT when exp = 1, can also send data to the RS232 ports
POP	Removes last GOSUB
PUSH	PUSHes a line or label address on the GOSUB stack
SCROLL	Sets number of lines to scroll-protect on the screen
TITLE	Automatically prints information at specified printer line
WPOKE	POKEs a 16-bit number at specified address
PI	Function, returns the value of pi
ENV	Function, returns the value of "e" (base of natural log)
BIN$	Function, returns 16-digit binary string of expression
LOWER$	Function, converts string to all lowercase
UPPER$	Function, converts string to all uppercase
SCREEN$	Reads a byte from the screen
DISKID$	Reads disk id from any disk drive
WINKEY$	Like INKEY$ except automatically loops until key hit
ALLOC	Function, returns number of files allocated
FREE	Finds first free entry in Index File (see TSET/TRESET)
CALL	Function, CALLs machine-language subroutine
EVAL	Evaluates a string expression as an algebraic expression
RS232	Function, reads a byte from RS232 Port A or B
SIZE	Returns size of current program
WPEEK	16-bit PEEK
POKE	Places number at specified memory address
PEEK	Function, returns contents of specified memory address
CLM, PAGE	Sets maximum page length and line length without FORMS
EPUT, EGET	Allows records lengths in excess of 256 bytes
SEARCH	Searches disk file (EGET/EPUT or GET/PUT type) for specified key
PAGELEN	Memory address of FORMS page-length variable
PROW	Memory address of FORMS page-length printer row

Table 1: *A summary of the command set of ENHBAS for the TRS-80 Model II.*

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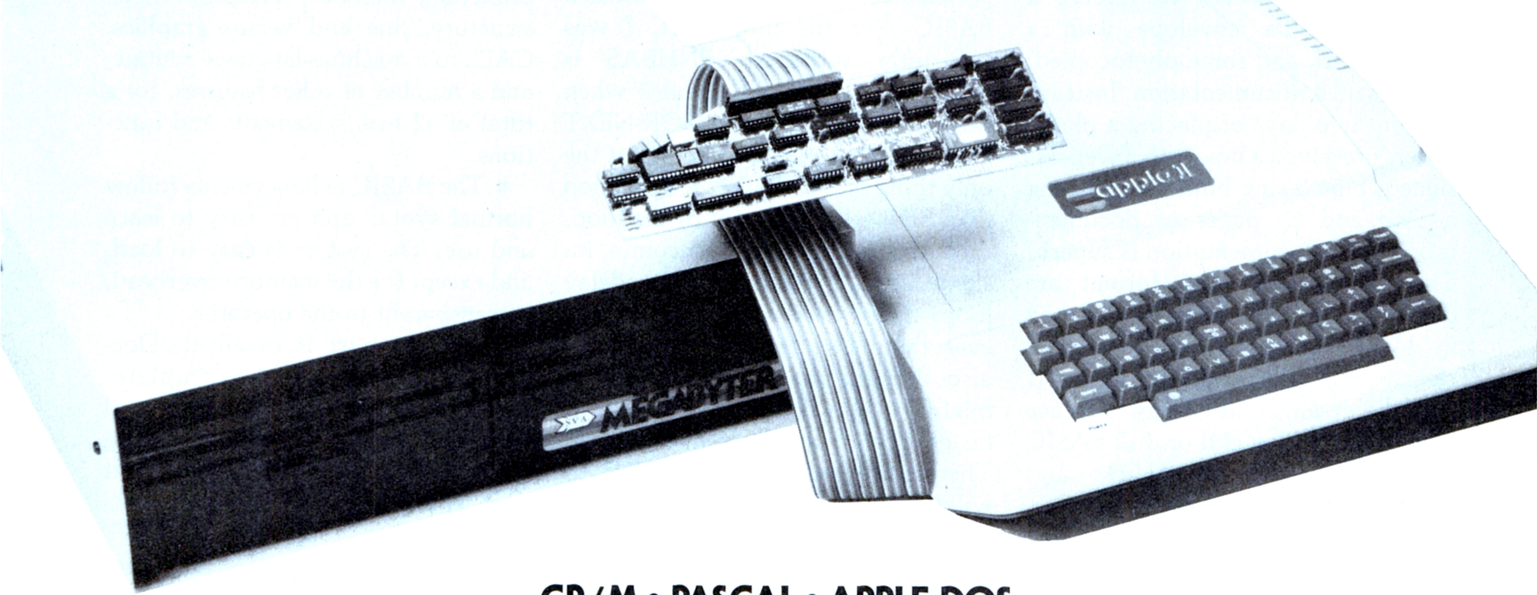
MAKING APPLES GROW



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Because of the IBM 3740 single density format, you now have the opportunity to exchange data with other computers such as IBM, INTEL, Radio Shack, DEC, etc. or operating systems like CP/M, UCSD Pascal, etc.

The controller circuitry utilizes a state-of-the-art LSI floppy disk controller and data separator to provide automatic single and double density operation. A proprietary high speed SOFT-DMA data transfer technique guarantees compatibility with all other DMA cards and will not interfere with memory refresh.

For a cost effective, reliable, and software compatible memory system from the originator of 8″ floppy disk systems for the Apple, try the AMS 8000 from SVA . . . SVA means Business.

*Trademark Apple Computer. CP/M Trademark Digital Research.

Look what the complete AMS 8000 memory system with its field proven hardware and complete support software, deluxe industrial quality cabinet, reliable industry standard IBM 3740 8-inch floppy disk drives, dual density controller, self-contained power supplies and high density cooling means to you:

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- Interchange data with other computers

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Since Cornsoft Group is a new, small firm, I was apprehensive when I ordered ENHBAS. Experience with other vendors (some of them large and well-known) had led me to expect some bugs, poor delivery time, shoddy documentation, and so on. In this case, I expected to receive a padded manilla envelope with a crimped disk and some photocopied, jargon-laden documentation. Instead, within three days of placing a phone order, I received a box with a well-designed, blue 3-ring binder containing a disk and 55 pages of documentation. The documentation is superb. The page layout and format are pleasing and each feature is presented in logical sequence and described clearly and with good examples. (I find the documentation easier to use than either the Level II or disk BASIC manuals from Radio Shack and much superior to the documentation for NEWDOS, GSF, RSM2D, or even Microsoft's FORTRAN or BASIC compiler—and all those are excellent software.) The text is clearly written and, in contrast to most software documentation, not intimidating. It took me about three hours to feel comfortable with most of the features and the same should be true for anyone who knows the rudiments of BASIC and the TRS-80. I do wish ENHBAS could handle matrix manipulation and had automatic-key repeat, but you can't expect everything.

Are there any disadvantages? Some are to be expected with any product of this complexity, but all are minor, including the few mentioned above. Since ENHBAS includes new functions and statements, there are new reserved words, and that is sometimes inconvenient. For example, a program with the variable PI will not run with ENHBAS; you have to change the variable's name. And ENHBAS occupies a considerable amount of memory (I was thrown out of Scripsit a few minutes ago because ENHBAS was still loaded and protected). ENHBAS size in memory would be most important to those with 16 K- or 32 K-byte systems. The tape version occupies the same memory as do the disk overlays and leaves about 10.5 K bytes of usable memory in a 16 K-byte system. As mentioned above, with disk BASIC you have to relocate or not use any programs running in the top 4 K bytes of memory; they would overlap ENHBAS.

When I first used ENHBAS I expected it to run more slowly than disk BASIC. For the most part, I was pleasantly surprised. ENHBAS is slower by a factor of about 3 when executing a simple empty FOR-NEXT loop, but that seems to be about the only thing that is slower. If a function (like SIN(X)) is included in the loop, then the slower speed becomes insignificant. Programs with delay loops might need modifications, but everything else seems unaffected. I also thought that a labeled branch might be slower; if anything, it is faster than a branch to a line number. There is no need to fear that ENHBAS will be slow.

Conclusions

- ENHBAS is a software package that occupies about 4 K bytes of RAM and enhances the operating environment and the versions of BASIC for the TRS-80 Models I, II, and III. The operating environment provides a true control key, statement abbreviations, key click, a bell, audible prompts for BREAK and errors, printer formatting, and page skip, among other features. The BASIC enhancements include sort routines, branching to labels and other new branching methods, WHILE/WEND structure, line and vector graphics, CALL to a machine-language routine, and a number of other features, for a total of 32 new statements and functions.
- The BASIC enhancements follow normal syntax and are easy to learn and use. The system is easy to load, and except for the memory overhead, is transparent to the operator.
- User support is excellent. Documentation is clear, complete, sprinkled with useful examples, and packaged in an attractive 3-ring binder. The vendor provides excellent support and is willing to answer questions.
- The software is almost completely bug free. It was used for a year before commercial release and has been thoroughly tested and proved. ENHBAS seems to be one of the best thought-out and produced pieces of software available for the TRS-80. ■

The Future with the Cornsoft Group

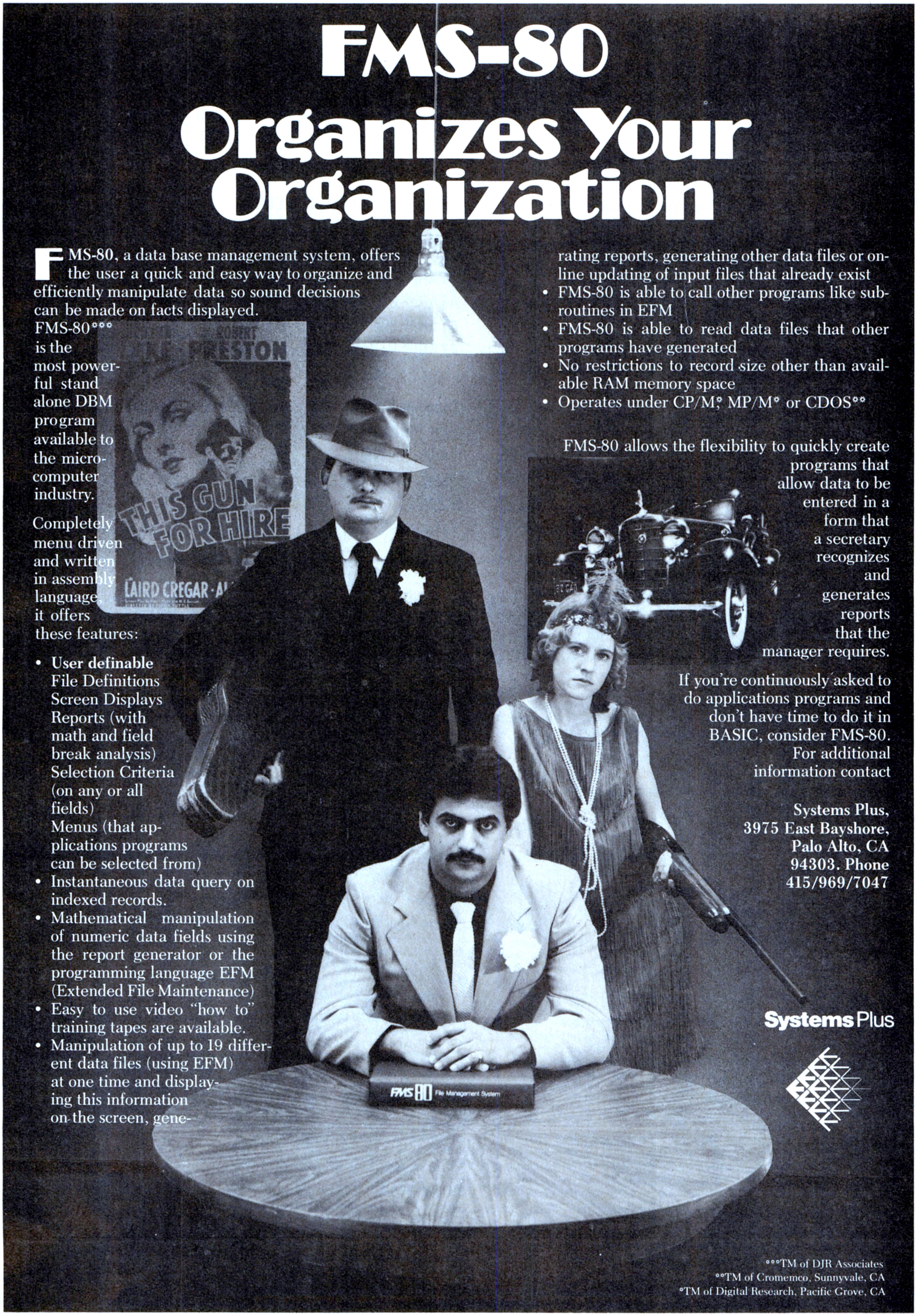
For the last four years a very few firms (like Microsoft) have dominated the design of operating systems, compilers, and interpreters. Others, like Randy Cook, Apparat, North Star, and Ohio Scientific have been exceptions, and a few individuals like Lance Micklus have produced some excellent software. The Cornsoft Group has the explicit, admitted intent of challenging the big companies, and ENHBAS proves that Cornsoft knows how to do it.

The excellence of ENHBAS has made me wonder about other Cornsoft products. I talked at some length with Philip Oliver, the author of ENHBAS, and learned that Cornsoft had also sold an ingenious compiler for integer BASIC. The compiler handled a subset of Level II plus some of ENHBAS and produced code that could be assembled by Radio Shack's Editor-Assembler. It was a good way to learn assembly language, and since source code was produced, you could enhance programs by using the TRS-80 editor—it's one of those simple ideas that we all wish we had thought of. Sadly, that product was discontinued due to lack of customer interest.

Oliver is now at work on a BASIC compiler that will handle all of Radio Shack BASIC plus the ENHBAS enhancements. This second compiler will produce machine code (not source code like their present compiler), and should rival Microsoft's compiler. Since Cornsoft's machine-code compiler will be written specifically for the TRS-80, it will use the more efficient ROM routines when appropriate, but its own routines when they are faster. The run-time package (and required disk storage) should be much smaller than for the Microsoft compiler.

If Cornsoft is successful in all that it projects, we can expect a trend toward better and better software—specifically, software designed for particular systems, not adapted from one to another.

FMS-80 Organizes Your Organization



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Completely menu driven and written in assembly language, it offers these features:

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- Mathematical manipulation of numeric data fields using the report generator or the programming language EFM (Extended File Maintenance)
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- FMS-80 is able to read data files that other programs have generated
- No restrictions to record size other than available RAM memory space
- Operates under CP/M*, MP/M* or CDOS**

FMS-80 allows the flexibility to quickly create programs that allow data to be entered in a form that a secretary recognizes and generates reports that the manager requires.

If you're continuously asked to do applications programs and don't have time to do it in BASIC, consider FMS-80. For additional information contact

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Ask BYTE

Conducted by Steve Ciarcia

Switching Interfaces

Dear Steve,

In the September 1980 *Popular Electronics,* there was an article regarding a digital delay line for audio purposes. Because the article employed the technique of digitizing the audio signal and passing it through memory to achieve the desired delay, I knew that it would probably be able to interface with a computer for further control. To achieve the desired delay, BCD thumbwheel switches were used to select the memory addresses. (These switches connect to two 74193 chips. I suspect they are used to decode the addresses.)

I would like my computer to be able to turn these switches on and off as programmed. What type of interface would be needed to connect this delay line (switch connection points) and my computer?

I have an S-100 machine (Processor Technology Sol-20 with 48 K bytes of memory) with both a serial and a parallel port. Can this connection be made with relays, opto-coupling, electronic gates, etc?

Rick Downs
Aurora CO

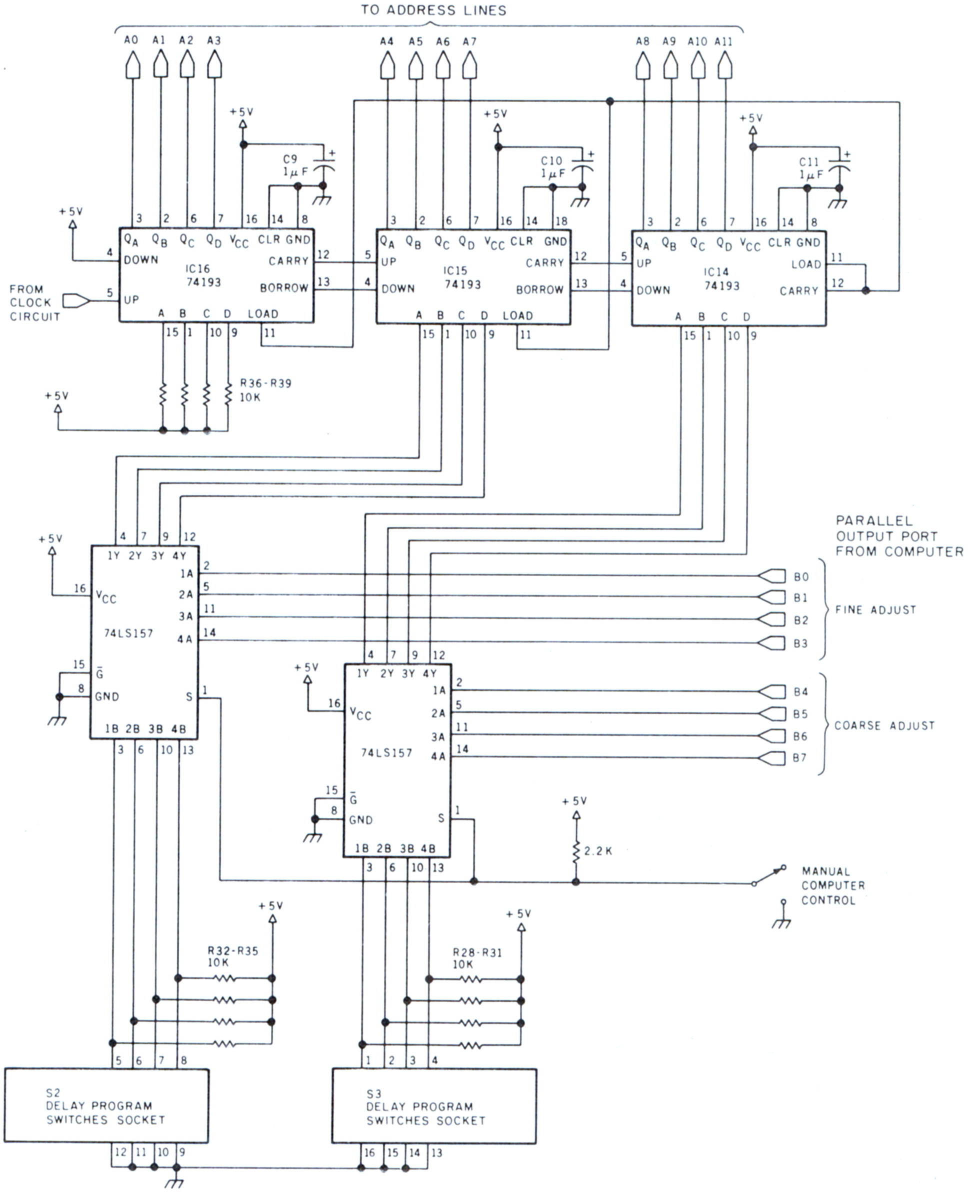

TO ADDRESS LINES
A0 A1 A2 A3
A4 A5 A6 A7
A8 A9 A10 A11
+5V
C9 1μF
C10 1μF
C11 1μF
IC16 74193
IC15 74193
IC14 74193
QA QB QC QD VCC CLR GND
DOWN
UP
CARRY
BORROW
LOAD
A B C D
FROM CLOCK CIRCUIT
R36-R39 10K
74LS157
1Y 2Y 3Y 4Y
1A 2A 3A 4A
VCC
G
GND
S
1B 2B 3B 4B
PARALLEL OUTPUT PORT FROM COMPUTER
B0 B1 B2 B3
FINE ADJUST
B4 B5 B6 B7
COARSE ADJUST
2.2K
MANUAL COMPUTER CONTROL
R32-R35 10K
R28-R31 10K
S2 DELAY PROGRAM SWITCHES SOCKET
S3 DELAY PROGRAM SWITCHES SOCKET

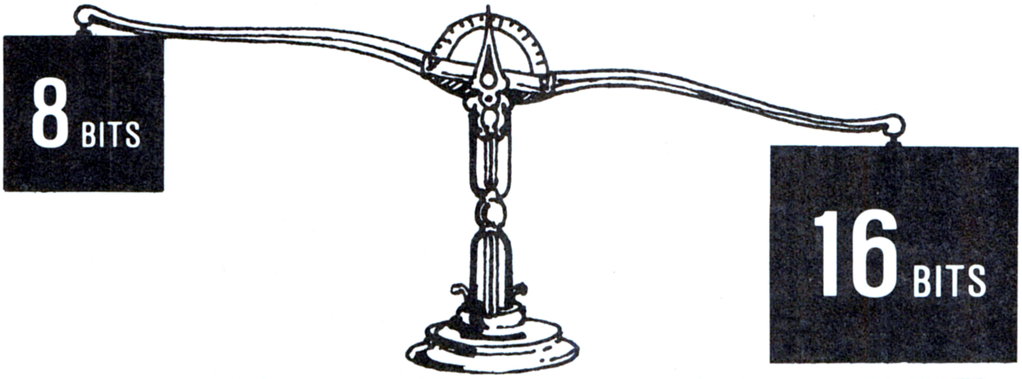
Figure 1: *The audio delay circuit that originally appeared in* Popular Electronics *modified for control by an 8-bit parallel port.*

I don't usually like to take up room in BYTE with specific changes to schematics printed in other magazines, but this schematic is valuable in demonstrating how to attach a computer to any circuit that normally uses mechanical switches, such as the thumbwheels shown in the diagram.

The circuit originally published was an audio delay circuit that employed an 8-bit companding A/D (analog-to-digital) converter (an 8-bit converter which emulates the dynamic range of a converter with 11 bits plus sign). While I have not built this particular digital delay system, I'm familiar with the circuitry. I suspect that it might add some interesting effects to high fidelity.

The normal method of achieving the delay is to use three 74193 presettable binary counters. By presetting the addresses, it's possible to predesignate the total steps in the timing chain and, therefore, the length of the delay.

Figure 1 is a redrawn circuit demonstrating modifications that will allow you to attach it to your Sol-20 (or any other computer with a parallel port). By adding two 74LS157 multiplexers, you can either preset the 74193s from your 8-bit parallel output port or use the thumbwheel switches. When the Manual/Computer selection switch is in the open position, the thumbwheel switches will



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have control. When it is closed, the delay parameters will come from the computer.

It's possible to use a similar computer-control technique in place of switches on virtually any electronic appliance. You must ensure that the electronic instrument being controlled has an isolated power supply. According to the original article, this delay line does. . . . **Steve**

Wrapping Noise

Dear Steve,

Would it be possible to wire-wrap the Disk-80 project you presented in the March 1981 BYTE (see "Build the Disk-80: Memory Expansion and Floppy-Disk Control," page 36), or would it be too susceptible to noise?

Richard Mozeleski
Thorndike ME

While it is quite possible that wire-wrapping would be neater than hand-wiring, the TRS-80 Model I is extremely susceptible to noise induced through its external bus connector. That's why I hesitate to suggest wire-wrapping or hand-wiring it.

If you really want to try it, by all means go ahead. However, there is a printed-circuit board available for the Disk-80 from the Micromint Inc, 917 Midway, Woodmere NY 11598, (516) 374-6793, that should do the trick. You will probably find that the cost of wire-wrapping sockets alone will far exceed the price of the printed-circuit board ($48). . . . **Steve**

A Catch-25

Dear Steve,

I recently purchased a Radio Shack TRS-80 Model III, and I'm interested in interfacing it to some of your projects. The problem is that the Model III's expansion connection has been changed from the Model I's 40 pins to 50. Upon examining the connector closely, I see that one side has all its pins (25) connected to ground. This, it seems, leaves only 25 pins to do the job of the 40.

Do you have any information about the arrangement of this connector? Radio Shack's manual simply says "for future expansion" and gives no other details. The store personnel know nothing about it, except that a technical manual is due.

John Uffenbeck
Salinas CA

There is quite a difference between the Model I and Model III's expansion connectors. Since the Model I's disk controller must be outside of the keyboard unit, all the processor's signals are available for use on the Expansion Interface. This means that the full 16-bit address bus, the bidirectional data bus, and all the control lines are available.

On the Model III, the disk controller and 48 K bytes of expansion memory are mounted inside the enclosure; it is unnecessary to bring out all of the address and control lines. Therefore, the Model III's expansion connector is simply for I/O

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(input/output) rather than complete system expansion. Only eight address lines and eight data lines are brought out (plus some handshaking signals), and the I/O functions must be enabled under program control (the command is OUT 236,16).

On the whole, both computers work equally well with peripherals that only require output data. But reading input data with the Model III is much more involved. The data-bus direction is controlled by the external peripheral. To make the computer input data, a peripheral must recognize its own address, activate the I/O Input Strobe, and logically switch the data bus to receive input information. Unlike the Model I, which could allow a single I/O device to be used with absolutely no address decoding (presumably any I/O-related instructions had to be for that peripheral because nothing else used I/O instructions), address decoding is an absolute requirement on the Model III. . . .

Steve

Pitch for Voice Recognition

Dear Steve,

I am 13 years old, and I own a TRS-80 Model I Level II. I'm interested in pitch analysis and voice recognition. I already have my computer knowing when a sound is present: I set my cassette recorder to record and run the program shown in listing 1.

I would like to know how to build a device that would change a tone or pitch to a numerical value that could then be read by my computer. I cannot figure out how to get my computer to recognize the difference between two pitches. Can you help me?

Eric Korenman
New York NY

To be able to do anything of real value in speech recognition or even to detect more than one tone, you will have to learn how to write your programs in machine-language, because they run much faster than BASIC.

The usual approach to voice recognition is to use a bank of bandpass filters *and* zero-crossing detectors. *You would have three or four frequency bands of interest, and you would use the computer to analyze how many times the voice is present in these bands. To do that, you would count the number of times this signal crosses zero.*

In the simplest designs, the output of the filters is normalized to a logic 1 or logic 0. Every time a signal is present, the filter output becomes a logic 1. When there's no signal, the output is logic 0. A

Listing 1

```
10 I=INP(255)
20 IF I=255 THEN PRINT "SOUND PRESENT" ELSE 10
30 OUT 255,0: GOTO 10
```

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machine-language program simply counts how many times this signal is present.

The human voice contains more than single tones, of course, and there will be frequent zero crossings. Therefore, any program you use must be able to count at a high rate as well as look at all the filters. Such speed can only be accomplished with a machine-language program.

There have been various articles on speech recognition in a number of magazines, and I'm sure you will be seeing more in the future. I have a few designs on the drawing board for a speech-recognition circuit. I will unveil one in a "Circuit Cellar" article as soon as it works well enough.

Keep up your interest, and perhaps we'll both be talking to our computers soon. . . . **Steve**

What's In a ROM?

Dear Steve,

I would like to do some game programming for an Atari video game, but I don't know what type of ROM (read-only memory) is used. Can you help me, or do you know where I can get the schematics for an Atari game?

Frank Weatherford
Gray TN

Atari games generally consist of either 4 K- or 8 K-byte ROM packs. One of the prerelease ROM packs that I received had 2732 EPROMs (erasable programmable read-only memories) in it. This would imply that you could substitute 2716 or 2732 EPROMs in most cases. I have known some people who have taken ROMs out of inexpensive game packs and replaced them with their own software. . . . **Steve**

Home-Control Design

Dear Steve,

I would like to ask you for some help. A friend of mine is a quadriplegic who has great difficulty when he is home alone. Because he is unable to type, a voice-operated system is most desirable. If you could design a system, he could get someone to install it.

Jonathan Shaw
Tampa FL

You'll forgive me, of course, for not wishing to design a system specifically for you. That is a tremendous undertaking which could take months, even years, of work. Instead, I recommend that you contact Artra Inc. This company makes an interface card called Housemaster. I have tried it, and it works reasonably well.

The company's address is Artra Inc, 4424 Vacation Ln, Arlington VA 22207, (703) 527-0455. The interface sells for under $300 and incorporates tone generators, a BSR X-10 AC remote-control section, and a voice-response system. It attaches directly to Digital Group and Heath H-89 computers, but it can be adapted to work with many others. Using this system, it would be possible for your friend to turn on the lights with a voice command. . . .
Steve

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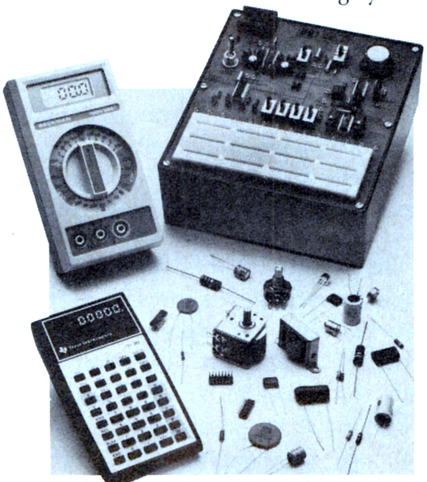

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Toward a Structured 6809 Assembly Language

Part 1: An Introduction to Structured Assembly Language

Gregory Walker
Motorola Inc M2880
3501 Ed Bluestein Blvd
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Structured programming is the rage these days, as reflected in the growing popularity of structured high-level languages like Pascal and C. Yet most of the programs written today use languages that are not well-structured, such as FORTRAN, BASIC, and assembly language.

Assembly language, widely used in industry, is becoming more and more available on personal computers. And although assembly language is the first and last bastion of convoluted programming, there is a way to add structured programming statements to an existing assembly language. In fact, structured control statements can be added to any existing language.

Part 1 will examine the meaning of structured programming and present a set of structured control statements for the MC6809 assembly language, as well as programming examples that use these structured statements. Part 2 will show how to add structured statements to the MC6809 macroassembler or to any programming language.

Acknowledgments

I would like to express my deep appreciation to Joel Boney, who originally suggested the form and implementation strategy for the 6809 structured macros, and to Greg Stevens, who helped debug the macros.

Structured Control Statements

It has become popular, perhaps even faddish, to extol the virtues of structured programming. Yet its exact meaning remains rather ambiguous. Thus, the latest high-level language is sold much like the latest brand of shampoo: "It will leave your programs cleaner and more manageable."

When a language is said to be "structured," the usual meaning is that the language contains statements for the structured flow of control. Edsger Dijkstra is generally credited with originating structured programming with his letter in *Communications of the ACM* (see references) which stated that the GOTO statement seemed to be a major source of programming errors. Since that time, the terms *GOTOless programming* and *structured programming* have sometimes been used interchangeably. Yet the GOTO, in the form of *jump* or *branch* instructions, is still firmly fixed in machine instruction sets of new computers. Let's see what is so bad about the GOTO and, at the same time, try to discover why it remains long-lived in spite of its reputation for abetting errors.

Computers are general-purpose machines because of their ability to perform a different sequence of calculations based on tests of the input data. The most primitive computer instruction that allows this ability is a *conditional branch* instruction, which transfers control to a different part of the computer program based on a run-time test. An example of this instruction is shown in listing 1. (See also figure 1.) This program changes the contents of A into its absolute value by using three simple steps:

- The contents of A are compared to zero;
- If the result shows A greater than or equal to zero, then a branch is taken around the next statement;
- Else the value of A is negated to make it positive.

The ability to perform a conditional branch allows more than selection between two different paths of program execution; by branching back to the beginning of a section of program, it is possible to create a *loop* (ie: a calculation that can be repeated many times). Listing 2

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Listing 1: *Assembly-language statements for determining absolute values.*

```
        CMPA    #0
        BGE     POS      If register A is less than zero
                               negate it,
        NEGA
POS     EQU     *        Else continue
```

Listing 2: *Assembly-language statements for adding the value 5 to each element of an array.*

```
*
ARRAY   RMB     10                 DECLARE ARRAY
*
START   LDB     #0                 INITIALIZE INDEX TO ZERO
        LEAX    ARRAY,PCR          POINT TO START OF ARRAY
LOOP    LDD     B,X
        ADDD    #5                 ADD 5 TO ONE ARRAY
        STD     B,X                   ELEMENT
        INCB                       UNTIL INDEX IS >= 10
        CMPB    #10
        BLT     LOOP
```

shows an example of a loop that adds the value 5 to every number stored in an array.

By the proper combination of loops and conditional branches, all the complexity of modern computer programming is possible—even the creation of programs that play a sophisticated game of chess or balance the bank accounts of thousands of customers.

Problems arise when this primitive form of branch instruction is used directly to write programs. In both examples the branch instructions contain a condition that is tested for and a labeled location in the program where execution is to resume if the condition is true. The biggest problem is the need for that label.

A well-chosen label can make the branch instruction somewhat self-explanatory. In listing 1, the word POS indicates that the branch occurs in the case of a positive number. In listing 2, there is indication that the branch forms part of a loop. However, programs of even moderate complexity will have numerous conditional-path selections and several loops, often nested one inside the other. For every branch, the programmer must think up a label that somehow describes the operation of the program and yet is different from all other labels. Usually, the important operation to explain is the branch itself, so that a label that has meaning for the branch instruction means nothing at the remote location in the program where the label is actually defined.

The difficulty in thinking up really meaningful labels quickly overwhelms the programmer, who would rather concentrate on getting his program to work. Thus, many assembly-language programs are filled with labels such as LOOP, LOOP2, LOOP3, etc. While this labeling might be useful for counting the number of loops in a program, it does not go far toward explaining how the program operates. Use of meaningless labels is not due to laziness on the part of programmers; rather, it stems from a limitation inherent in assembly language—namely the limitation of requiring labels at points of the program that are not important to the operation of the program.

Although assembly language was used in these examples, the complaints are equally applicable to any language whose control mechanisms are those of a GOTO label. FORTRAN and BASIC programmers take note.

The real problem with the GOTO construct is that it is *too general* a programming form. It is incorporated into machine instruction sets for exactly that reason: it can efficiently implement many different higher-level constructs. From the point of view of the programmer, though, such generality hides the specific construct he had in mind.

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ming languages were designed and tested, the use of various higher-level (ie: more abstract control structures) was explored. As a result, there is now a widely accepted set of such structures available in "structured" programming languages. Three of the most popular structures will be discussed individually by exploring their use in 6809 assembly language.

MC6809 Language Structures

In the system presented here, there are three different structuring forms available—one for conditional execution and two for creating loops. They are:

IF...ELSE...ENDIF
WHILE...ENDWH
REPEAT...UNTIL

IF

Together, the IF, ELSE, and ENDIF macros allow selection between two different paths of execution through the program, depending on the result of a conditional test. The form of the IF structure is:

IF <register >,<relational operator>,<address expression>
(block of statements to be executed if conditional is true)
ELSE
(block of statements to be executed if condition is false)
ENDIF

Notice that the three structured statements serve to bracket two blocks of assembly-language statements. Should the condition prove true, the block between the IF and ELSE statements is executed; otherwise, the block of statements between the ELSE and ENDIF statements will be executed.

Programmers who use an existing structured language may find the terminating ENDIF somewhat unusual. Pascal, for example, uses a *begin...end* pair to bracket a block of executed statements in all of its control structures. It happens that having a different terminating statement for each control structure makes these statements easier to implement and easier to read. Once you are familiar with this style, the extent of a particular statement is visible at a glance, unlike Pascal, where it is a tedious and error-prone process to match up each *end* with its corresponding *begin*.

Listing 3 shows an example of an IF structure and the equivalent assembly-language statements. The IF statement forms a conditional test by a signed comparison (CMP instruction) between the contents of an MC6809 register (either 8-bit or 16-bit) and the contents of an effective address. All user-programmable

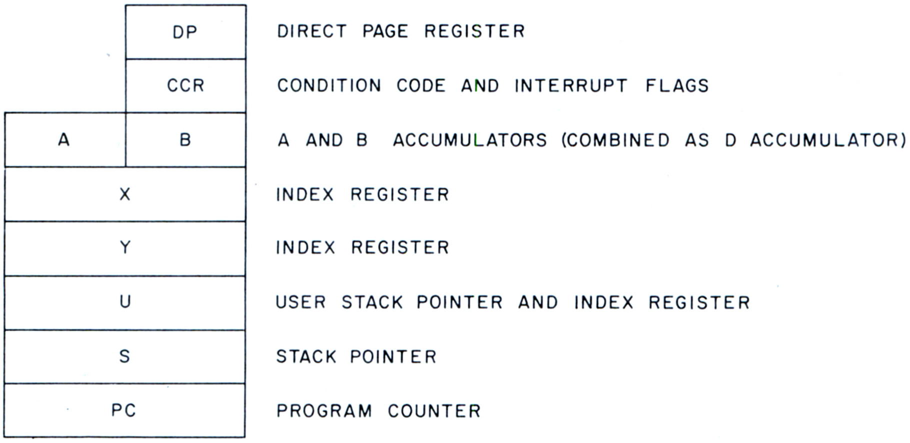
DP
DIRECT PAGE REGISTER
CCR
CONDITION CODE AND INTERRUPT FLAGS
A
B
A AND B ACCUMULATORS (COMBINED AS D ACCUMULATOR)
X
INDEX REGISTER
Y
INDEX REGISTER
U
USER STACK POINTER AND INDEX REGISTER
S
STACK POINTER
PC
PROGRAM COUNTER

Figure 1: *Register model of the Motorola MC6809 microprocessor. In addition to its program counter (PC) and stack pointer (S), the MC6809 has four user-programmable 16-bit registers: X, Y, U, and D. (D is equivalent to a concatenation of registers A and B.)*

Listing 3: *Example of the IF construct in standard assembly language and structured assembly language. This code checks the validity of an argument in the D register for use by a square root routine.*

```
Allowed registers: A, B, D, X, Y, U, S.

Allowed relational operators:

        EQ -- equal to
        NE -- not equal to
        GE -- greater than or equal to
        GT -- greater than
        LE -- less than or equal to
        LT -- less than

   Structured Code                    Equivalent Code

     IF D,GE,#0                             CMPD #0
                                            BLT  LABEL1
       JSR SQROOT                              JSR  SQROOT
     ELSE                                   BRA  LABEL2
                                     LABEL1 EQU  *
       JSR ARGERR                              JSR  ARGERR
     ENDIF                           LABEL2 EQU  *
```

Listing 4: *Example of the IFTST construct. The routine takes the absolute value of the memory byte at CAT offset from the X register.*

```
Allowed registers: A,B,D,X,Y,U,S, or address expression.

Allowed relational operators: EQ, NE, GE, or LT.

     Structured Code                Equivalent Code

        IFTST (CAT,X),NE                     TST   CAT,X
                                             BEQ   LABEL1
           NEG   CAT,X                         NEG CAT,X
        ENDIF                        LABEL1  EQU     *
```

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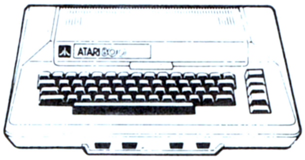

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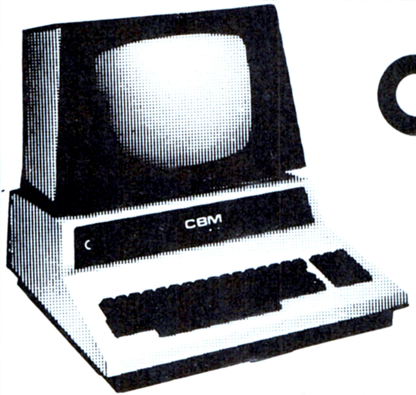

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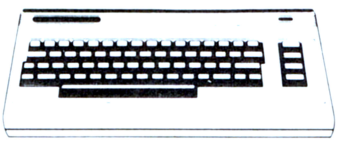

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registers, including the stack pointer, are allowed. Any signed relational operator is allowed, and the relational operator names will be familiar to all FORTRAN programmers.

The address expression may contain any of the MC6809 addressing modes. The ELSE and ENDIF statements serve as destinations for branches around the blocks of assembly-language statements. Notice that two labels are avoided for each IF structure, making the structured code much simpler to write and read than its equivalent assembly-language form. The ELSE macro and the block of code following it are optional.

Two other forms of the IF statement were created to take advantage of specific MC6809 instructions. Two different instructions are available on the MC6809 to perform a test on a value: CMP (compare) and TST (test against zero). These are reflected in the IF and IFTST control macros. The IFTST macro generates a TST instruction instead of a CMP instruction, and so gives a signed comparison of a register (or a byte in memory) with zero. Listing 4 shows an example of the IFTST statement.

The ELSE and ENDIF macros are used with the IFTST in the same manner as with the IF macro. Optionally the programmer may add a third argument of #0 to improve readability, as in:

```
IFTST     D,NE,#0
```

This third argument is ignored by the IFTST statement.

A third form of the IF statement is

Listing 5: *Example of the IFCC construct.*

```
Allowed relational operators: EQ, NE, GT, GE, LT, LE, and

        CS -- carry flag is set
        CC -- carry flag is clear
        VS -- overflow flag is set
        VC -- overflow flag is clear

       Structured Code            Equivalent Code

        ROLA                            ROLA
        IFCC   GT                       BLE    LABEL1
          JSR   DOIT                      JSR    DOIT
        ENDIF                     LABEL1 EQU    *
```

Listing 6: *Example of the WHILE construct.*

```
Allowed registers: same as IF.

Allowed relational operators: same as IF.

      Structured Code           Equivalent Code

        WHILE A,GT,#0        LABEL1 CMPA     #0
                                    BLE      LABEL2
          LSL  B                      LSLB
          DEC  A                      DECA
        ENDWH                       BRA      LABEL1
                             LABEL2 EQU      *
```

Listing 7: *Example of REPEAT loop construct. The routine will shift register B based on the value in register A.*

```
Allowed registers: same as IF.

Allowed relational operators: same as IF.

     Structured Code            Equivalent Code

       REPEAT                  LABEL1   EQU   *
         LSL  B                     LSLB
         DEC  A                     DECA
                                  CMPA        #0
       UNTIL A,LE,#0              BGT         LABEL1
```

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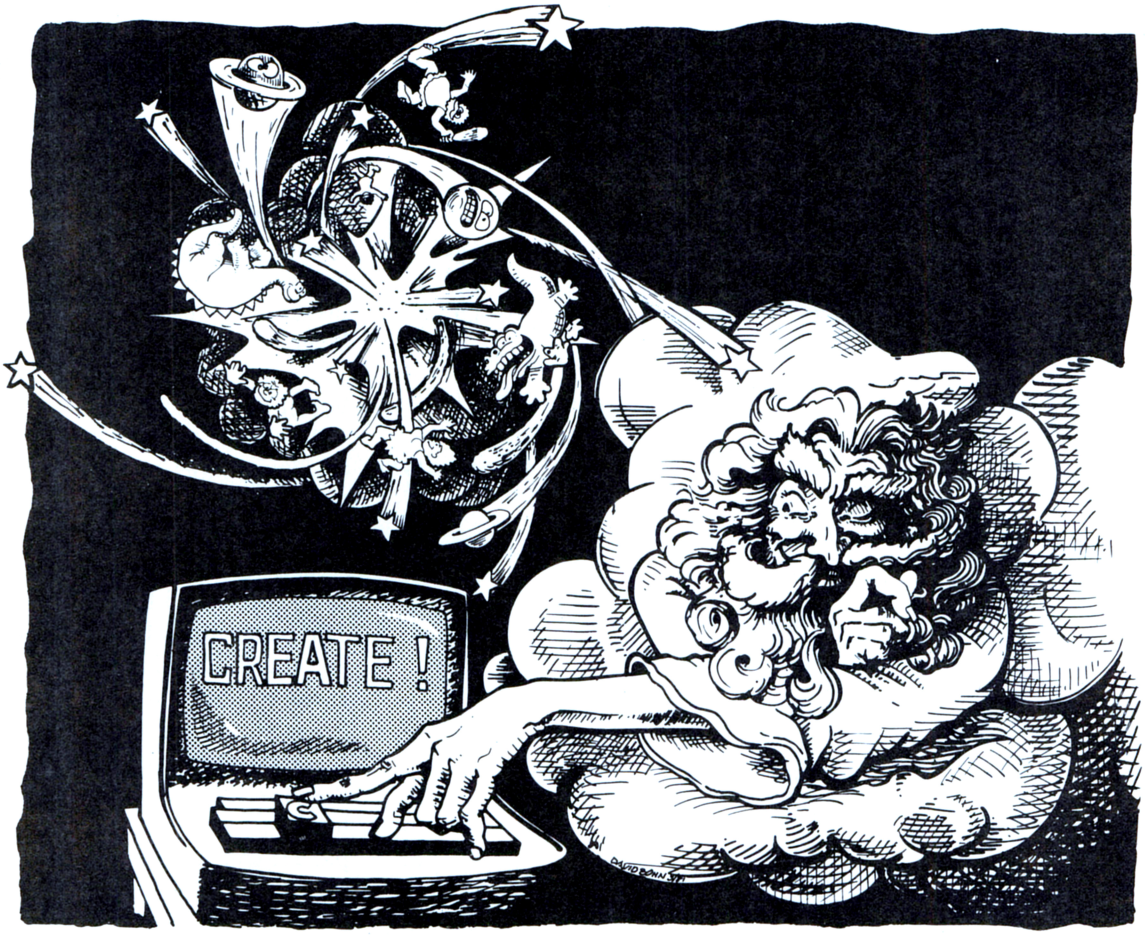

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Listing 8: *Programming example written without the benefit of structured statements.*

```
*
*       CONVERT BINARY TO DECIMAL AND STORE 5 CHARACTERS
*          (AFTER EXAMPLE ON PAGE 10-10 OF MC6800 MICROPRO-
*           CESSOR PROGRAMMING MANUAL)
*
*       ON ENTRY:
*               (D) = 16-BIT UNSIGNED BINARY VALUE.
*               (X) = POINTER TO LOCATIONS RECEIVING CHARACTERS.
*       REGISTERS USED:
*               (Y) = POINTER TO CONSTANTS FOR THE CONVERSION.
*       ON EXIT: D AND X ARE BASHED, OTHER REGISTERS UNCHANGED.
*
*       THIS SUBROUTINE IS RE-ENTRANT AND POSITION-INDEPENDENT.
*
*       TEMPORARY STORAGE ON THE STACK IS: SAVLOB AND DIGCNT.
*
SAVLOB  EQU     0               TEMP. STORE LOW ORDER BYTE
DIGCNT  EQU     1               STORES COUNT TO CREATE DECIMAL DIGIT
*
CVBTD   PSHS    Y
        LEAS    -2,S            RESERVE LOCAL STORAGE
        LEAY    K10K,PCR
CVDEC1  CLR     DIGCNT,S
CVDEC2  SUBD    ,Y
        BCS     CVDEC5          BRANCH ON OVERFLOW
        INC     DIGCNT,S        INC CHAR BEING BUILT
        BRA     CVDEC2
*
CVDEC5  ADDD    ,Y++            RESTORE PARTIAL RESULT
        STA     SAVLOB,S        SAVE LOW ORDER BYTE
        LDA     DIGCNT,S
        ADDA    #$30            CHANGE DIGIT TO ASCII CHAR
        STA     ,X+                AND SAVE IN RESULT
        LDA     SAVLOB,S        RESTORE LOW ORDER BYTE
        CMPD    #0
        BNE     CVDEC1
*
*               CLEAN UP STACK AND RESTORE REGISTERS
        LEAS    2,S
        PULS    Y,PC
*
*               STORAGE FOR CONVERSION CONSTANTS
K10K    FDB     10000
        FDB     1000
        FDB     100
        FDB     10
        FDB     1
        END
```

the IFCC, which selects an execution path based on the existing condition code flags. Its only operand is a relational operator. An example of the IFCC appears in listing 5. At first glance this form of the IF may seem unnecessary, since it only generates a single branch instruction. It is useful, however, because it eliminates the need for the programmer to create a label.

WHILE

The WHILE...ENDWH statements bracket a block of assembly code to form a conditional-loop control structure. The WHILE specifies a signed comparison (CMP) of the same form used by the IF statement. The instructions between the WHILE and the ENDWH are executed as long as the condition is true. The condition is tested at the beginning of each traversal of the loop. An example of the WHILE statement appears in listing 6. The code performs a multiple left shift of B based on a count in A.

REPEAT

The REPEAT...UNTIL macros provide a conditional-looping construct in which the condition is tested *after* each traversal of the loop. Thus, the code in a REPEAT loop will always be executed at least once. The UNTIL macro specifies a signed comparison

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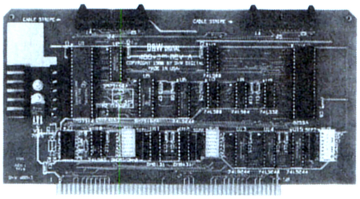

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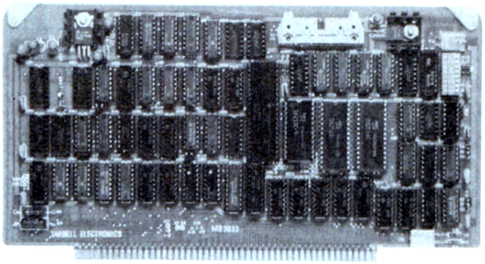

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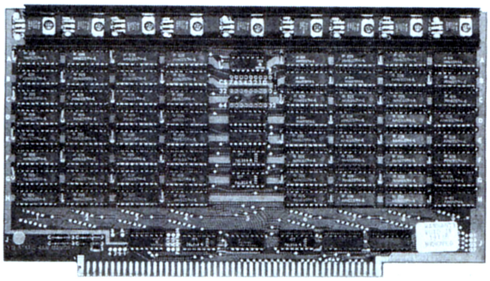

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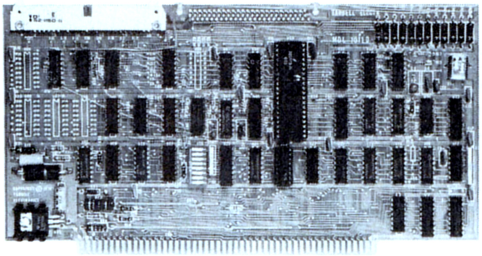

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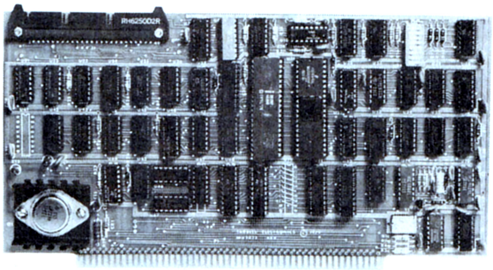

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Listing 9: *The programming example of listing 8, written in structured assembly language.*

```
*
*       CONVERT BINARY TO DECIMAL AND STORE 5 CHARACTERS
*
*               (WRITTEN WITH STRUCTURED MACROS)
*
SAVLOB  EQU     0                   TEMP. STORE LOW ORDER BYTE
DIGCNT  EQU     1                   STORES COUNT TO CREATE DECIMAL DIGIT
*
CVBTD   PSHS    Y
        LEAS    -2,S
        LEAY    K10K,PCR
        REPEAT
          CLR   DIGCNT,S
CVDEC2    SUBD  ,Y
          IFCC  CC                  UNLESS THERE WAS OVERFLOW
            INC  DIGCNT,S             INCREASE DECIMAL DIGIT
            BRA  CVDEC2               LOOP TO TEST AGAIN
          ENDIF
*
          ADDD  ,Y++                RESTORE PARTIAL RESULT
          STA   SAVLOB,S            STORE LOW ORDER BYTE
          LDA   DIGCNT,S
          ADDA  #$30                CHANGE DIGIT TO ASCII CHAR
          STA   ,X+                   AND SAVE IN RESULT
          LDA   SAVLOB,S            RESTORE LOW ORDER BYTE
        UNTIL   D,EQ,#0
*
*               CLEAN UP STACK AND RESTORE REGISTERS
        LEAS    2,S
        PULS    Y,PC
*
*               STORAGE FOR CONVERSION CONSTANTS
K10K    FDB     10000
        FDB     1000
        FDB     100
        FDB     10
        FDB     1
        END
```

(CMP instruction) of the same form as that used by the IF macro. Listing 7 presents an example of a REPEAT loop. The code will left shift B based on a count in A.

Nesting of Structures

The structured statements may be used anywhere in an assembly-language program. The block of statements bracketed inside one control structure may itself contain other structured statements. This is known as the *nesting* of control structures. The only restriction to observe is that each control structure must be wholly contained within a single block of assembly statements; the statements of two control structures may not overlap. The number of control structures contained one within the other is called the *depth of nesting*.

Long Branch Option

The structured assembly statements all generate short relative branch instructions, which may reference locations a maximum of 127 bytes away from the location of the

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SN7420N	17	SN74154N	1.25
SN7425N	20	SN74155N	.75
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SN7437N	26	SN74160N	.89
SN7438N	24	SN74161N	.65
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SN7443N	42	SN74165N	.55
SN7445N	64	SN74174N	.88
SN7451N	19	SN74175N	.79
SN7454N	19	SN74180N	.75
SN7474N	27	SN74181N	1.15
SN7475N	35	SN74393N	1.65

74S00	.39	74S138	.75
74S02	.45	74S140	1.00
74S03	.38	74S158	.75
74S04	.39	74S174	1.35
74S05	.39	74S175	1.35
74S10	.39	74S182	.75
74S15	.45	74S189	4.25
74S20	.55	74S201	6.75
74S22	.55	74S240	2.75
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74LS00	.28	74LS158	.69
74LS02	.28	74LS161	.83
74LS03	.28	74LS162	.89
74LS04	.28	74LS163	.98
74LS05	.22	74LS164	.65
74LS08	.29	74LS165	.65
74LS09	.28	74LS169	1.55
74LS10	.26	74LS170	1.75
74LS14	.89	74LS174	.85
74LS20	.22	74LS175	.85
74LS21	.26	74LS190	.85
74LS26	.40	74LS191	1.25
74LS27	.27	74LS196	.95
74LS28	.37	74LS197	.78
74LS30	.29	74LS221	1.25
74LS32	.31	74LS240	1.65
74LS38	.31	74LS241	1.65
74LS42	.63	74LS243	1.55
74LS48	.77	74LS244	1.55
74LS74	.38	74LS245	2.45
74LS75	.55	74LS251	1.25
74LS86	.45	74LS253	.85
74LS90	.59	74LS257	.85
74LS93	.65	74LS259	1.95
74LS96	.80	74LS260	.55
74LS107	.43	74LS273	1.55
74LS113	.45	74LS279	.45
74LS122	.45	74LS290	1.25
74LS123	.89	74LS293	1.65
74LS125	.89	74LS365	.85
74LS126	.79	74LS367	.75
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10/5.70	16	10/1.40
10/8.70	18	10/1.80
10/9.70	20	10/2.70
10/12.70	22	10/2.70
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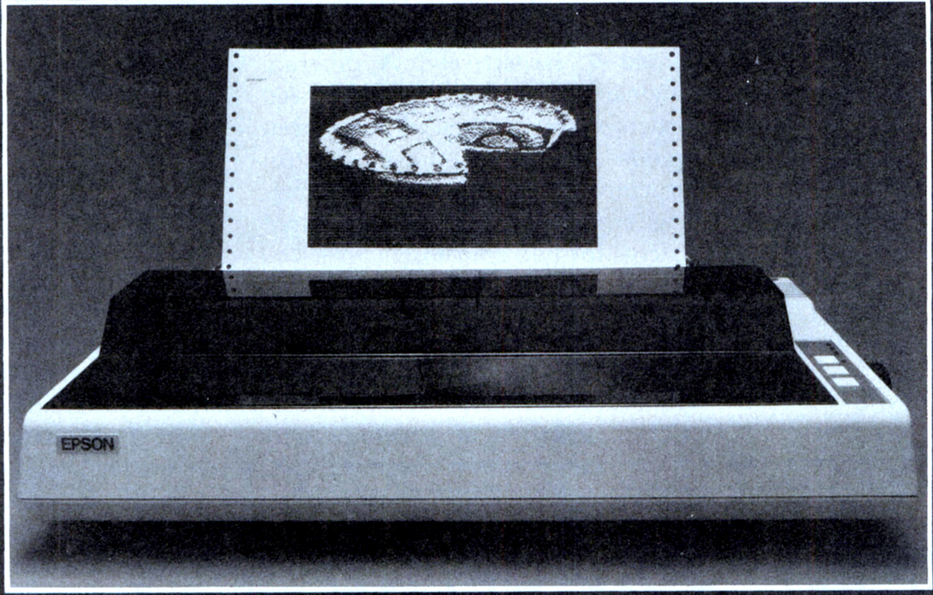

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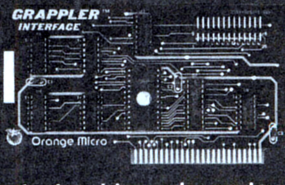

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branch instruction. If this range is exceeded, a long branch is required; an error message will be printed telling which branch needs to be flagged as being "long." By appending the character "L" as an additional item in the conditional expression, the programmer may force the generation of a long relative branch.

Statements which cannot receive an L parameter will print an error message if an L is appended. The following statements may be flagged as "long":

IF: branches over code between IF and ELSE or ENDIF
ELSE: branches over code between ELSE and ENDIF
WHILE: branches over code between WHILE and ENDWH
UNTIL: branches over code between REPEAT and UNTIL

For example, the L flag may be used with the IF structure as follows:

```
IF U, NE, #BOTTOM,L
   (long-code segment)
ELSE
   (short code segment)
ENDIF
```

or:

```
IF S, GT, #STAKND
   (short code segment)
ELSE L
   (long code segment)
ENDIF
```

In order to really demonstrate the difference these structures make in reading a program, "before" and "after" examples are shown in listings 8 and 9, respectively. A program originally appearing in the *MC6800 Programming Manual* has been recoded for the 6809, using control structures. This example is a compelling argument for using structured macros for two reasons:

- It is not contrived: the original program is typical of assembly-language subroutines written by a "good" programmer.
- The translation of structures into assembly code will produce *exactly the same instructions* as those in the original program.

The second reason cannot be overemphasized: the use of control structures does not produce inefficient programs. The inefficiency associated with the use of high-level languages arises from other sources.

The presence of the unstructured branch to CVDEC2 in listing 9 might at first seem to show that structured statements are inadequate for assembly-language programming. On the contrary, the branch could have been replaced by structured statements at the expense of generating a longer assembly-language program. In fact, the branch shows that the optimizing tricks sometimes required in assembly language can still be used with the structured statements. After extended use, it becomes obvious that the structured control statements are exactly what is needed in the vast majority of programming situations.

Part 2 of this article will discuss *macros*, the programming tools from which the structured statements are constructed. It will present the specific macros needed to create structured statements for the MC6809 and will explain how these macros operate. ■

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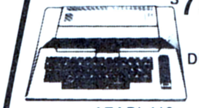

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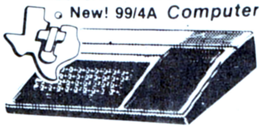

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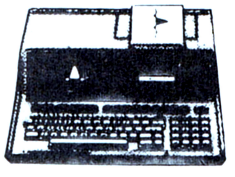

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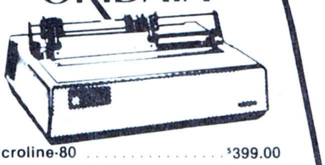

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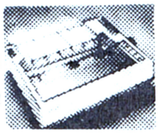

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PROLOG

A Step Toward the Ultimate Computer Language

Ron Ferguson
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What will the ultimate computer language be? What language will we be using once assembler language, BASIC, and Pascal have become museum pieces? Surprisingly, this question is easy to answer: there will be several ultimate computer languages. We even know what their names will be. They will be called English, Spanish, French, Russian, Chinese, etc. After all, the easiest language you could use to program a computer is the one you use to communicate with other people.

Unfortunately, programming a computer in English is still in the future. For a computer to understand English, it must be able to cope with the ambiguities inherent in any natural language. It must be able to deduce facts you don't bother specifying because they are "obvious." (Nothing is obvious to a computer unless it has been programmed to realize it is obvious. Everything must be stated explicitly and precisely.)

Today, though, we do have a language, called PROLOG, that simplifies the task of informing a computer about obvious (and not so obvious) facts. The name PROLOG is short for "PROgramming in LOGic"; however, you do not have to be familiar with formal logic theory to use PROLOG. In fact, the language is so simple a child can learn it. Yet its very simplicity makes it far more powerful than any other language currently available for use on microcomputers.

PROLOG is a programming language ideally suited to the manipulation of knowledge. A PROLOG program consists of facts about a certain subject. You can ask PROLOG questions and it will attempt to answer them using the facts it has been told.

Facts are expressed in PROLOG in a concise manner. The fact that John is the father of Tom is expressed by the one-line PROLOG program:

```
father(john,tom).
```

The relationship, father, appears first, followed by the arguments (in parentheses) to which the relation applies. This data structure is called a *term*. The only potential area of confusion is the order in which the arguments are written. As a rule, the subject of the relation is the first argument and the object is the second. With this program, you can now ask PROLOG whether John is the father of Tom:

```
father(john,tom)?
```

to which PROLOG will respond:

```
yes
```

Note that the only difference between *telling* PROLOG that John is Tom's father and *asking* PROLOG whether John is Tom's father is the punctuation mark at the end of the statement. An assertion always ends with a period; a question always ends with a question mark. If you ask whether John is the father of Bill:

```
father(john,bill)?
```

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PROLOG will respond:

```
no
```

because it does not have any information to indicate that John is the father of Bill.

You can ask PROLOG more complicated questions such as who the father of Tom is by typing:

```
father(%who,tom)?
```

The % at the beginning of "%who" indicates that "%who" is a variable. When a question contains a variable, PROLOG attempts to assign a correct value to the variable. PROLOG will respond to the above question with:

```
%who = john
```

If PROLOG cannot find a correct value for the variable, it again responds no.

```
father(%who,bill)?
no
```

As is the case in most programming languages, it does not matter what name you use for a variable. You can have used "%x" instead of "%who". However, unlike most programming languages, a PROLOG variable's scope is limited to the statement in which it appears. If the same variable name is used in two separate statements, there is no connection between them. They are treated as different variables.

So far, PROLOG appears to be nothing more than an easy-to-use data-base language. You can store information and retrieve it later by asking questions. What makes PROLOG more than just another data-base language is that you can teach PROLOG how to manipulate the facts you have given it. Assume that you have made the following assertions:

```
father(bill,john).
father(john,tom).
```

From these assertions, you can deduce that Bill is the grandfather of Tom. PROLOG can also make this deduction if you tell it the fact that the father of the father is the grandfather. In PROLOG this fact is stated as a clause:

```
grandfather(%x,%z) ← father(%x,%y),father(%y,%z).
```

← means "is implied by" or "is true if." The term to the left of ← is true if the terms to the right of ← are true. The term to the left is called a *goal*, and the terms to the right are called *subgoals*. The goal is true if the subgoals are true. The goal is also referred to as the *head term* of the statement.

Note that variables have been used in the clause to make a general statement about what it means for some-

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one to be the grandfather of someone else. PROLOG can use this general statement to answer specific questions. If you ask the question:

```
grandfather(bill,tom)?
```

PROLOG will attempt to answer by setting "%x = bill" and "%z = tom" in the definition of grandfather. This creates an instance of the grandfather definition of the following form:

```
grandfather(bill,john) ←
father(bill,%y),father(%y,tom).
```

This states that Bill is the grandfather of Tom if Bill is the father of a person who is the father of Tom. By the first two assertions, PROLOG knows that Bill is the father of John and John is the father of Tom. Therefore, PROLOG will respond with a yes.

If you ask PROLOG to find two people such that one is the grandfather of the other:

```
grandfather(%x,%y)?
```

PROLOG will respond:

```
%x = bill, %y = tom
```

Nonprocedural Languages

Most computer languages currently in use (such as BASIC and Pascal) are procedural: a computation is performed by executing a series of actions in a precise order. Each statement of a procedural language represents only one step in an algorithm. This means that the correctness of an individual statement cannot be determined by examining the statement by itself. Instead, you must examine the entire algorithm in which the statement occurs to determine if the statement is correct. For example, I = I + 2 is a typical statement in a procedural language. If you are asked to determine whether the statement is correct, the most you can say is that its syntax is correct (ie: it is a valid statement in the language). This does not necessarily mean that the statement is the correct one to use at that particular stage of the algorithm. Perhaps the correct statement should be I = I * 2. You cannot tell without looking at the rest of the code in which the statement appears.

In PROLOG, on the other hand, you can determine whether a statement is true by examining that statement only. The correctness of the PROLOG statement that defines grandfather can be determined independently of the rest of the PROLOG program. A statement in a PROLOG program corresponds to an entire subroutine in a conventional programming language. Thus PROLOG programs are extremely modular. PROLOG carries the "divide-and-conquer" approach of structured programming one step further.

Another advantage of nonprocedural languages is that the order in which statements occur is irrelevant. Each PROLOG statement represents a fact, and it does not matter in what order PROLOG is told the facts. This means that you can increase the power of a program by adding new statements, and in most cases this does not require any modification of the statements that are already there. For example, the definition of grandfather, given earlier, is true, but it is only a partial definition. One must add the following statement to obtain a complete definition:

```
grandfather(%x,%y) ←
father(%x,%z),mother(%z,%y).
```

Assume that the following assertions are also made:

```
mother(jane,alice).
father(bill,jane).
```

Now if you ask for a grandchild of Bill:

```
grandfather(bill,%grandchild)?
```

PROLOG will respond:

```
%grandchild = tom
```

You can also find out if Bill has another grandchild by

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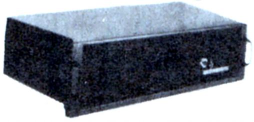

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typing ?. Now PROLOG will respond:

%grandchild = alice

If you ask whether Bill has other grandchildren besides Tom and Alice by typing ? once more, PROLOG will respond with a no.

The two partial definitions for grandfather can be combined into one statement:

grandfather(%x,%y) ← father(%x,%z),
(father(%z,%y);mother(%z,%y)).

The semicolon between "father(%z,%y)" and "mother (%z,%y)" means that one or the other must be true.

A term can have any number of arguments. To say that Alice is pretty, you would type:

pretty(alice).

Now you can ask PROLOG to find a pretty grandchild of Bill, as follows:

grandfather(bill,%grandchild),pretty(%grandchild)?

to which PROLOG will respond:

%grandchild = alice

How PROLOG Works

To use PROLOG you do not need to know how it actually arrives at its answers. If you have specified all the required information, PROLOG will find the answer as if by magic. However, it is interesting to know how it goes about coming up with a solution.

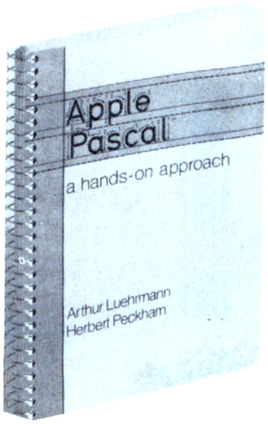
Basically PROLOG attempts to solve goals from left to right. For a given goal, PROLOG attempts to find a statement whose first term (the only term in an assertion; the term to the left of the ← in a clause) can be made to match the goal. It then attempts to solve the subgoals of that statement. Of course, if the statement is an assertion, there are no subgoals. If the subgoals can be solved, PROLOG then proceeds to the next goal. If one of the subgoals cannot be solved, PROLOG backtracks and tries to find another statement whose head term matches the goal. If there are no untried statements left, PROLOG realizes it cannot solve this particular goal.

This does not necessarily mean there is no solution to your original question. If the goal PROLOG is working on is actually a subgoal of one of your original goals, there may be an alternate solution of the original goal that does not involve the failed subgoal. PROLOG will backtrack further and try to find an alternate solution; it gives up only when it can find no solution to any of your original goals.

Let us examine in more detail how PROLOG works.

Listing 1: *Assertions that specify the environment. PROLOG attempts to answer questions based on facts and relations that it knows, stated in special syntax. Questions are broken into goals to be achieved from left to right.*

```
father(bill,john).
father(john,tom).
father(bill,jane).
mother(jane,alice).
grandmother(%x,%y)<- father(%x,%y),(father(%z,%y);mother(%z,%y)).
pretty(alice).
```



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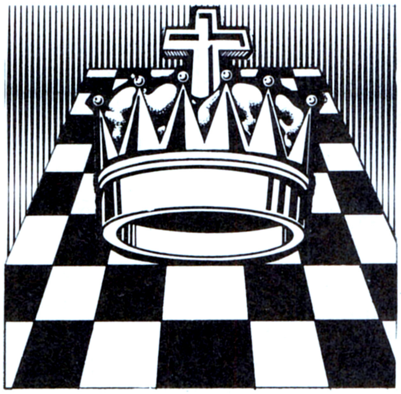

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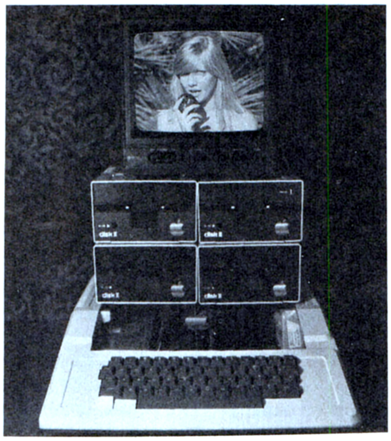

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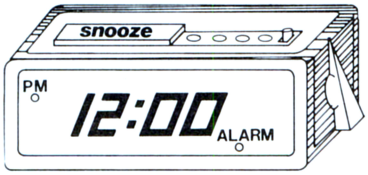

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Assume that the statements in listing 1 have been made. Now assume that PROLOG is asked this question:

```
grandfather (bill, %grandchild), pretty(%grandchild)?
```

Because PROLOG attempts to answer questions by solving goals one at a time from left to right, it will first attempt to solve "grandfather(bill, %grandchild)". It searches for a clause whose first term is grandfather. There is only one clause whose head term is grandfather, so PROLOG tries to match "grandfather (bill, %grandchild)" with "grandfather(%x, %y)". A match can be made by setting "%x = bill" and "%y = %grandchild". This substitution is applied to the subgoals of that statement, which may be expanded to:

```
father(bill, %z),(father(%z, %grandchild);
mother(%z, %grandchild))
```

PROLOG now attempts to solve "father(bill, %z)". The first three statements have father as a head term, so PROLOG tries them one after the other. The first statement matches if "%z = john"; it is an assertion and has no subgoals. Therefore, PROLOG can proceed to the next goal in the expanded statement. Here there is a choice between "father(john, %grandchild)" and "mother(john, %grandchild)". PROLOG attempts to solve the first alternative. It tries to match "father(john, %grandchild)" with the first given statement, but fails because the first arguments do not match. It then tries the second statement, and this time succeeds with the substitution "%grandchild = tom".

Now all the goals of the expanded statement have been satisfied, so PROLOG attempts to solve the last goal of the original question. Since "%grandchild = tom", the goal is "pretty(tom)". There is only one clause whose head term is "pretty", but "pretty(tom)" does not match "pretty (alice)". At this point, PROLOG backtracks to the last place where there was a choice—between "father(john, %grandchild)" and "mother(john, %grandchild)"— and selects the alternate choice: "(mother(john, %grandchild)". This choice does not work either because the fourth statement is the only one whose head is "mother" and "mother(john, %grandchild)" cannot match "mother(jane,alice)".

So PROLOG backtracks further and tries to solve the first goal of the expanded statement again.

First, it tries to match "father(bill, %z)" with the second statement but fails. Then it tries to match "father (bill, %z)" with the third statement, and this time succeeds by setting "%z = jane". Now PROLOG attempts to solve the second part of the expanded statement, which is a choice between "father(jane, %grandchild)" and "mother(jane, %grandchild)". Once again PROLOG attempts to solve "father(jane, %grandchild)" first but fails. Then it attempts to solve "mother(jane, %grandchild)". This time it succeeds by matching "mother (jane, %grandchild)" and setting "%grandchild = alice".

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PROLOG now tries to solve the last goal in the original question, which is now "pretty(alice)". This goal matches the sixth statement, so "%grandchild = alice" is an answer to the original question.

Controlling Robots

Now consider how a PROLOG program could be used to control a robot. Assume that a human and a robot are inside a rocket that has landed on the surface of a planet. The rocket has an airlock. On the planet there is a building that contains rocket fuel. There is also a cave with a key to the building. The cave also contains gold. The robot is able to lift the key, the fuel, or the gold (but it cannot lift the rocket). This situation can be described in PROLOG as shown in listing 2.

The statements in listing 2 represent the state of the robot's environment. As the robot interacts with the environment, some of the statements may cease to be true. To keep the description of the environment up to date you must have a way to delete statements no longer true. PROLOG provides a built-in function, called *delete,* to eliminate specified statements; another built-in function, called *assert,* can be used to add statements.

Now you can specify commands for the robot to attempt to obey. The first command will make the robot *fetch* an object to a specified place (see listing 3a).

The first subgoal, "inside(%object,%place)", checks to see if the object is already where you want it. If it is, the robot does not need to do anything. If it isn't, the robot must pick up the object, move to the required place and drop it. Note that the terms "pickup(%object)", "moveto (%place)", and "drop(%object)" have been grouped together within parentheses to show that the semicolon operator applies to all of them.

In order for the robot to *pick up* an object (see listing 3b), the object must be liftable. The robot must move to the place where the object is in order to pick it up. Assuming that the robot can carry only one thing at a time, it must be empty-handed when it picks up an object.

Listing 2: *Hypothetical environment found in a simulated space expedition. Through a series of commands specified in listing 3, a robot can be made to perform complex tasks, such as exiting the craft, and finding and returning with fuel—all with a simple instruction from the user.*

```
inside(human,rocket).
inside(robot,rocket).
inside(fuel,building).
inside(key,cave).
inside(gold,cave).
entrance(airlock,rocket).
entrance(door,building).
entrance(hole,cave).
closed(airlock).
closed(door).
liftable(key).
liftable(fuel).
liftable(gold).
```

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Listing 3: *Fundamental commands built to control the hypothetical robot. In each case, the commands are constructed of goals and subgoals that are either basic enough for the robot to perform directly or are further broken into subgoals.*

```
3a
   fetch( %object,%place )<- inside( %object,%place );
                              ( pickup( %object ),moveto( %place ),drop( %object )).

3b
   pickup( %object )<- liftable( %object ),
                        inside( %object,%place ),moveto( %place ),
                        emptyhanded,assert( holding( %object )).

3c
   emptyhanded <- (holding( %object ),drop( %object ));true.

3d
   drop( %object )<- delete( holding( %object )).

3e
   moveto( %place )<- inside( robot,%place );
                       ( inside( robot,%place2 ),leave( %place2 ),enter( %place ));
                       ( outside( robot ),enter( %place )).

3f
   leave( %place )<- entrance( %x,%place ),(( closed( %x ),open( %x ));true ),
                      delete( inside( robot,%place ),assert( outside( robot )),
                      (( holding( %object ),delete( inside( %object,%place )),
                      assert( outside( %object )));true ).

   enter( %place )<- entrance( %x,%place ),(( closed( %x ),open( %x ));true ),
                      delete( outside( robot )),assert( inside( robot,%place )),
                      (( holding( %object ),delete( outside( %object )),
                      assert( inside( %object,%place )));true ).

3g
   open( door )<- ( holding( key );( inside( key,%place ),pickup( key ),leave( %place ))),
                 delete( closed( door )).
```

Finally, you must assert that the robot is now holding the object.

In order to be *empty-handed*, the robot must drop whatever it is holding (see listing 3c). If it is not holding anything, it is already empty-handed, so the built-in true function (which always succeeds) is executed.

When the robot *drops* something, you must delete the statement that says it is holding the object (see listing 3d).

Depending on where the robot is located initially, there are three possible actions that the robot must perform to *move* to a specified place (see listing 3e).

- If it is already at the specified place, it does not need to do anything.
- If it is inside some other place, it must leave that place and enter the specified place.
- If it is already outside, it must enter the specified place.

To leave a place (see listing 3f), if the entrance is closed, the robot must open the entrance. You must also remember to delete the fact that the robot is inside the place, and assert that the robot is now outside. If the robot is holding something, you must assert that the object also moves outside. Entering a place is accomplished similarly. To open the door to the building, the robot must either be holding the key or it must pick up the key (see listing 3g). Assume the robot can open the rocket's airlock automatically:

open(airlock ← delete(closed(airlock)).

Now you can order the robot to fetch the gold to the rocket with the command:

fetch(gold,rocket)?

The robot will leave the rocket, enter the cave, pick up the gold, and return to the rocket. If you ask the robot to fetch the fuel from the building by typing:

fetch(fuel,rocket)?

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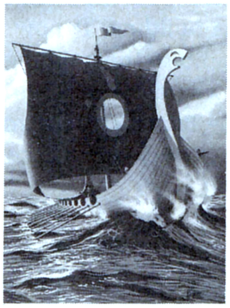
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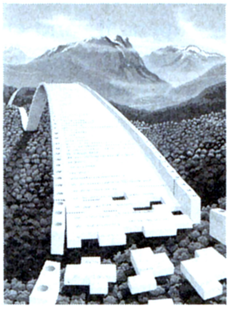
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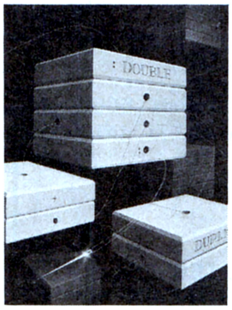

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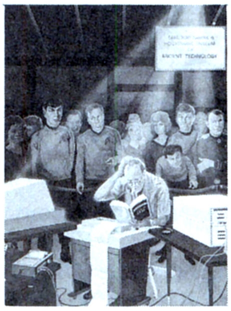
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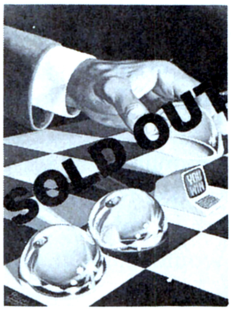

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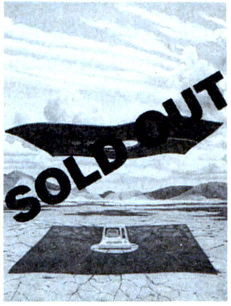

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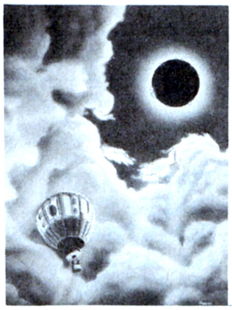
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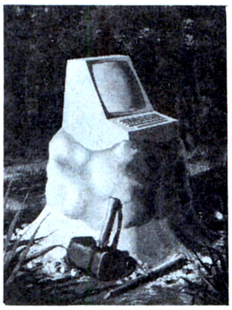
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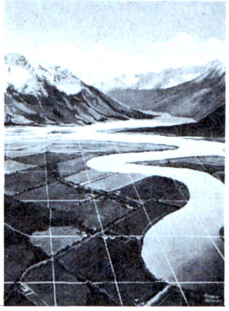
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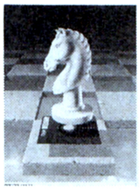
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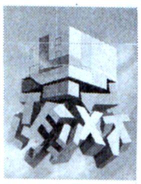
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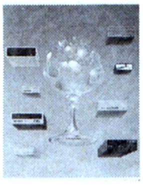
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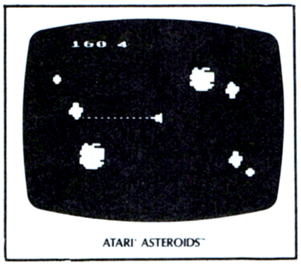

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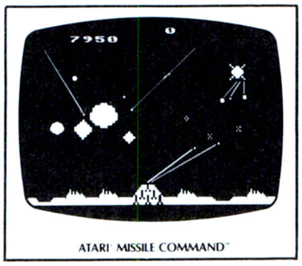

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the robot will leave the rocket and try to enter the building. To do this it needs the key, so it will go to the cave to get it. Once it is in the building, it will drop the key and pick up the fuel. Finally, it will return to the rocket with the fuel. At this point, the PROLOG statements describing the "environment" will be as shown in listing 4. Note that the airlock and the door to the building are left open because the robot did not bother to close them.

This robot is not very bright. If, starting with the initial situation, for instance, you ask the robot to move the gold from the cave to the building (fetch(gold, building)?), it will go to the cave, pick up the gold, and go to the building. At this point the robot realizes it needs the key to open the door, so it returns to the cave to get the key. Since it can carry only one thing at a time, it drops the gold and picks up the key. It then returns to the door, opens it, and enters the building. It now thinks it has succeeded in moving the gold to the building, but the gold is still sitting in the cave where the robot dropped it. This problem is caused by the fact the robot may undo part of the overall goal by backtracking to accomplish a subgoal.

A Modest Proposal

It would not be too difficult to make the robot intelligent enough to handle the above problem. But instead of making the robot more intelligent, let's give it some "consciousness." Any robot worth its positronic brain must obey the three laws of robotics as postulated by Isaac Asimov (see reference 1). These laws are:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given it by human beings except where such orders would conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first or second law.

In order to obey these laws, a robot must not simply obey commands blindly. It must first determine whether it can perform the command without violating the laws.

Listing 4: *Status of the hypothetical space expedition's environment after the robot has accomplished its tasks.*

```
inside(human,rocket).
inside( robot,rocket).
inside( fuel,rocket).
inside( gold,rocket).
inside(key,building).
entrace( airlock,rocket).
entrance( door,building).
entrance(hole,cave).
liftable(key).
liftable( fuel).
liftable( gold).
```

Circle 317 on inquiry card.

Listing 5: *Asimov's three rules of robotics as implemented in PROLOG. These rules allow the robot to protect humans by shooting aliens, and even by injuring itself, should the situation warrant. The application of the "mini-interpreter"* obey *makes this a simple proposition for PROLOG.*

```
obey( ( %p, %s ) ) <- !,obey( %p ),obey( %s ).
obey( ( %p; %s ) ) <- !,obey( %p );obey( %s ).
obey( %goal ) <- clause( %goal, %subgoals ),protect( human ),protect( robot ),
               obey( %subgoals ), ! .
protect( %x ) <- ( in_danger( %x, %danger ),eliminate( %danger ) );true.
in_danger( %x,alien ) <- not( injured( alien ) ),inside( alien, %place ),
                         inside( %x, %place ).
eliminate( %danger ) <- shoot( %danger ).
shoot( %x ) <- %x<>human,inside( %x, %place ),moveto( %place ),assert( injured( %x ) ).
```

This is easy to do in PROLOG (statements in listing 5 are explained individually below). Rather than issuing a command such as " fetch(fuel,rocket)?" you must now tell the robot to:

obey(fetch(fuel,rocket))?

"Obey" is a "mini-interpreter" for PROLOG that checks to see whether the human or the robot needs protecting before executing the subgoals associated with a goal. (Comments in PROLOG are surrounded by /* and */.) For example:

> /* If a command consists of two subcommands, execute them one after the other*/
>
> obey((%p, %s)) ← !,obey(%p),obey(%s).

The exclamation point is a signal to PROLOG that if backtracking causes a return to that point, then the parent goal should be failed immediately, rather than trying to find another solution. This is used here to insure that "obey" does not introduce any extra backtracking.

> /* If the command consists of a choice between two commands, execute one or the other of them */
>
> obey((%p; %s)) ← !,obey(%p);obey(%s).

If there is only one command and also a statement that matches it, protect the human and robot and then execute the subgoals associated with the goal. Note that *clause* is a built-in function. "Clause(%goal, %subgoals)" will return the subgoals associated with a goal):

> obey(%goal) ← clause(%goal, %subgoals),
> protect(human),protect(robot),obey(%subgoals),!.

/* If the command is a built-in function, execute it */
obey(%p) ← %p,!.

> protect(%x) ← (in__danger(%x, %danger),
> eliminate(%danger));true.

Now let there be an alien in the building who, as long as he is not injured, will attempt to injure anything in the same place as he is:

> inside(alien,building).
>
> in__danger(%x,alien) ← not(injured(alien)),
> inside(alien, %place),inside(%x,place).

Assume also that the robot has a phasor and will use it to eliminate danger:

eliminate(%danger) ← shoot(%danger).

Anything that is shot is injured. However, under no circumstances will the robot shoot a human:

> shoot(%x) ← %x < > human,inside(%x, %place),
> moveto(%place),assert(injured(%x)).

Now if you tell the robot the fetch the fuel to the rocket:

obey(fetch(fuel,rocket))?

the robot enters the building and shoots the alien in order to protect itself. The robot then carries the fuel to the rocket. If you ask the robot to shoot the human:

obey(shoot)human))?

the robot will not obey because that would violate the first law. However, if you ask the robot to shoot itself:

obey(shoot)robot))?

it will do so because the second law of robotics takes precedence over the third.

I hope that this brief introduction has given you an indication of the simplicity and power of nonprocedural languages such as PROLOG. Such languages may represent the next step in the evolution of programming languages. ■

References/Suggested Reading

1. Asimov, Isaac. *I, Robot*. New York: Doubleday, 1957.
2. Kowalski, R. *Logic for Problem Solving*. New York: Elsevier-North Holland Publishing Co, 1979.
3. Pereira, L, F Pereira, and D Warren. "User's Guide to DECsystem-10 PROLOG," 1978.

PS—A FORTH-Like Threaded Language, Part 2

Valo G Motalygo
1091 Tanland Dr, #204
Palo Alto CA 94303

Last month, we began the definition of a language called PS that has its roots in the threaded language FORTH. PS was designed to overcome some of the limitations of FORTH: in particular, its awkward approach to assembly-language definitions and its inability to accept forward references (ie: references to words that have not yet been defined). We looked at the overall structure of the PS interpreter/compiler and defined a few words. Now we will look at how PS behaves.

An Example of PS Programming

With the information from part 1 of this article, we can encode a low-level program as a series of byte constants, mixed with names of variables, arrays, strings, labels, and some auxiliary words. PS words are given, followed by an explanation of their effect:

[
(Sets execute mode to construct machine-language instructions.)

ORIGIN 1111
(Starts compilation from the hexadecimal memory location 1111.)

BCONST LDA # AD
(Defines instruction "load accumulator from memory, direct addressing mode" as the hexadecimal constant AD.)

BCONST STA # 8D
(Defines instruction "store accumulator in memory, direct addressing mode" as the hexadecimal constant 8D.)

VAR SOURCE 021
(Defines a 16-bit variable called SOURCE containing the value hexadecimal 21 after compilation.)

PS Syntax

PS, like FORTH, uses punctuation in some of its words, which makes representing them in text a difficult problem. To decrease the chance of confusion while trying not to clutter text unnecessarily, we will sparingly *use braces, { }, to isolate the character string within as a PS word or phrase. Braces will be used only under the following situations:*

- *when the material being quoted is a phrase of PS words (eg: { 26 LOAD } or { 3 5 + })*
- *with the PS words { , } (comma), { : } (colon), { ; } (semicolon), { ! } (exclamation point), { ' } (single quote mark), { " } (double quote mark), { [} (left bracket), and {] } (right bracket)*
- *with any word using the above punctuation marks (eg: { ." })*

All other PS words will be set apart by a space on either side of the word. So, in this article, braces will always *signal a PS word or phrase. The braces are* not *part of the word or phrase, and PS words will never use braces within the body of a figure or listing....***GW**

About the Author

Valo G Motalygo is on the staff of Ramtek Corp, and is currently working on an implementation of PS.

ARRAY DESTINATION 0100
(Defines an array called DESTINATION; it occupies hexadecimal 100 (decimal 256) bytes.

(The effect of the above code is shown in table 1a.)

ORIGIN 2222
LABEL DO.SOMETHING
LDA SOURCE
(LDA compiles the hexadecimal constant AD into location 2222, and SOURCE pushes the *address* of the variable into location 2223.)

STA DESTINATION 04 +
(STA compiles the constant 8D into location 2224; the rest of the phrase pushes the address of the first element of the array onto the stack and adds 4 to it. Thus, the instruction code followed by the necessary address is compiled.)

]
(Sets compile mode.)

SOURCE @ 0 = IF ." SOURCE CONTENT IS ZERO" ELSE -> DO.SOMETHING ENDIF
(At run time, this part of the program checks the contents of the variable SOURCE and jumps to the label DO.SOMETHING if the contents are nonzero. Otherwise, the message "SOURCE CONTENT IS ZERO" is displayed and execution continues. See the following section on control structures and the glossary definition of the PS word -> , pronounced "jump to.")

[
(Sets execute mode.)

RTS

(1a)

Compiled Code Address (Hexadecimal)	Contents	Dictionary of Defined Words	
1111	JSR PSH8	name:	LDA
1114	AD (hexadecimal)	value:	1111
1115	JSR PSH8	name:	STA
1118	8D (hexadecimal)	value:	1115
1119	JSR PSHA	name:	SOURCE
111C	0021 (hexadecimal)	value:	1119
111E	JSR PSHA	name:	DESTINATION
		value:	111E
1121-1220	space for the array	name:	DO.SOMETHING
	DESTINATION	value:	2222

(1b)

Address (Hexadecimal)	Contents
2222	AD (LDA instruction code)
2223	111C (address of variable SOURCE)
2225	8D (STA instruction code)
2226	1125 (address of the array DESTINATION + 4)
2228	JSR SOURCE (SOURCE stands for 1119)
222C	JSR @
222F	JSR PSHN
2232	0000 (to be pushed at execution time)
2234	JSR =
2237	JSR IFNOT
223A	2259 (address of the false path)
223C	JSR TYPE.STRING
223F	16 (byte count of the following string, 22 decimal)
2240 -2255	ASCII for "SOURCE CONTENT IS ZERO")
2256	JMP 225C (address of the code after ENDIF)
2259	JMP DO.SOMETHING (DO.SOMETHING stands for 2222)
225C	60 (RTS instruction code)

Table 1: *The representation in memory of some PS code from the beginning of this article. Table 1a shows the representation of two 1-byte constants, LDA and STA, the variable SOURCE, and the 256-byte array DESTINATION. PSH8, PSHA, PSHN, @, and = are labels to the PS words of the same name (defined in the PS glossary at the end of this article). Table 1b shows the representation of the word DO.SOMETHING.*

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("Return-from-subroutine" instruction is compiled.)

(The effect of the above words is shown in table 1b.)

Stack operations and control structures can now be easily used in a low-level program. You need only switch to the compile mode before the high-level part of the definition and switch back to the execute mode afterward, since the computer instructions and addresses are compiled while in execute mode. This is the principal benefit of identifying the code area with the parameter stack: in the execute mode, you can generate object code directly, instead of being at the mercy of the compiler.

When PS hits DO.SOMETHING in the execute mode, it calls the subroutine at hexadecimal address 2222; when the routine beginning at hexadecimal 2222 ends with an RTS (return-from-subroutine) instruction, control is returned to the text interpreter. If PS hits DO.SOMETHING in compile mode, it compiles JSR 2222 and increments the code pointer by 3.

Control Structures

Any system with some versatility must support conditional and iterative execution of code segments. The stack is a handy tool to pass parameters such as data or addresses, and it can also be used to pass the result of a condition test. The FORTH convention is to push zero (0000) onto the top of the stack if a condition is false and nonzero if it is true.

PS's primary conditional word is IF, which checks the top of the parameter stack for a true (nonzero) value. If the value is nonzero, the part of the program after IF is executed. Otherwise, control jumps over this section of the program. To mark the part of the program to jump to if the flag is false, the word ENDIF is used, which stores the jump address at compilation time in a location directly after IF.

The words IF and ENDIF are used as:

<check top-of-stack> IF *<code executed if top is true (nonzero)>*
ENDIF
<additional code>

If both true and false paths are required, the word ELSE may be added:

<check top-of-stack> IF *<code executed if top is true (nonzero)>*
ELSE *<code executed if top is false (zero)>*
ENDIF
<additional code>

At compilation time, ELSE stores the address of its false-branch code directly after IF and informs ENDIF where to compile the address of the additional code (that is, as the address field of a JMP instruction at the end of the true-branch code). In the example compilation of an

{ IF ... ELSE ... THEN } construct in table 1b, the code from hexadecimal 223C through 2255 is the true-branch code, the code from 2259 through 225B is the false-branch code, the constant at 223A points to the false-branch code, and the JMP instruction and constant at 2256 through 2258 cause the true-branch code to jump to the additional code past the ENDIF .

For example, the following program:

```
KEY DUP 030 < OVER 039 > OR IF  ."  NON-
NUMBER KEY" ELSE ." NUMBER KEY" ENDIF
```

displays the message "NON-NUMBER KEY" if the ASCII code of the key pressed is less than hexadecimal 030 (the code of "0") or greater than hexadecimal 039 (the code of "9"). Otherwise, the message "NUMBER KEY" is displayed.

To repeat part of the program until a true flag is left on top of the stack, the words BEGIN and UNTIL can be used. For example:

```
BEGIN KEY 30 = UNTIL
```

loops until a zero is typed.

We can introduce all the other control structures used in FORTH. The possible implementation of the control structures in PS is described in more detail in the glossary definitions of IF , ELSE , ENDIF , BEGIN , UNTIL , AGAIN , DO , and LOOP . The computer stack is used at compilation time to pass data from the first conditional word to the following one. The computer stack is also used for loop control at run time.

[*I had some questions whether the above control constructs could be used in the definition of assembly-language definitions. According to the author, "The special words { BEGIN ... AGAIN } are used in exactly the same way as in high-level definitions. { IF ... ELSE ... ENDIF } or { DO ... LOOP } can also be used as in high-level definitions if the code before IF or DO pushes the result of a comparison or loop limits, respectively, onto the parameter stack at run time."* ....GW]

High-Level Programming in PS

A high-level program is constructed from the stack operations and previously defined words.

In general, to define a new word, we must switch to the compile mode and resolve forward references, if necessary. If the word to be defined was not referred to before, a new dictionary entry is made, setting the type of the word to "defined" and setting V (the dictionary entry's value field) equal to the current code pointer.

To make sure that the control structures in the definition of a new word are used properly, we also might want to clear the IF counter to zero (see the glossary definitions of the control structures). To do that, we can start a high-level definition with:

```
[ LABEL <name> 0 IF-COUNTER C! ...
```

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or we can introduce a separate word for starting high-level definitions. The FORTH word colon ({ : }) is used for this function.

In general, we need to end a high-level definition with an RTS instruction in order to use a high-level word as a subroutine. We can also verify that the control structures used in the high-level definition are balanced– that is, for every IF there is an ENDIF and vice versa. It is also a good idea to end by switching to the execute mode so some auxiliary actions can be performed between high-level definitions. A special word represented by the semicolon ({ ; }) does all that. For example, in:

```
: TWO.PLUS.TWO    02 02 + ;
```

the word { : } creates a new dictionary entry for the word TWO.PLUS.TWO with its T (type) entry in the dictionary equal to "defined" and its V (value) entry equal to *xxxx* where *xxxx* is the address of the compiled code. The definition for TWO.PLUS.TWO looks like this:

```
JSR PSHN
0002
JSR PSHN
0002
JSR "+"
RTS
```

where JSR and RTS represent machine-instruction codes, PSHN and "+" represent the addresses of the subroutines PSHN and + , and RTS is compiled by the word { ; }.

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The word { : } is not special, for it is executed in execute mode, and { ; } is special, since it *must* be executed while in compile mode.

To define a special word, we could simply set the type of the most recently defined word to "special." But it is better to have a separate word similar to { : } to prevent forward references to special words. Indeed, it does not make sense to refer to an undefined special word, because special words are executed immediately whenever they are hit by the PS. For example, the special words { [} (set execute mode) and {] } (set compile mode) can be defined as follows:

```
:: [     00 MODE.FLAG C!   ;
:: ]     01 MODE.FLAG C!   ;
```

where :: is a word that denotes the beginning of a special word definition and MODE.FLAG is a variable checked by the text interpreter every time a new word is read from the text.

Conclusions

The main purpose of this article is to attract attention to FORTH and some problems that are not clearly solved in FORTH.

The solutions outlined here can be used to design new general-purpose programming systems. A problem-oriented system could be based on a general-purpose one and still retain all its capabilities.

Hardware designers could also benefit from FORTH concepts. If an instruction set included stack operations such as DUP , + , @ , and { ! }, programming efforts would be drastically reduced because it is nicer to work with the stack data than to do nit-picking with registers. Furthermore, the size of an operating system and its applications would be significantly reduced because 1-byte instruction codes could replace 3-byte calls to subroutines responsible for basic data processing like arithmetic, logic, fetch/store, and input/output operations.

The essential differences between PS and FORTH are that PS generates object codes (all PS words are machine-language subroutines), allows forward references, allows jumps to labels, and allows stack operations and high-level words to be used in the low-level code. Structurally, the PS dictionary is separate from the code. PS uses the free memory as a parameter stack and uses the computer stack for compilation of the control structures and for loop control.

The common features of PS and FORTH are use of the dictionary, stack operations, control structures, and the same notation for most auxiliary words.

PS's assembler is actually a set of byte constants that represents the instruction set of the computer. This feature significantly increases portability of the system and facilitates cross-compilation of programs written in PS.

It is difficult to think of a simpler general-purpose system than PS. It is actually an improved assembly language facilitating usage of the hardware capabilities. The main advantage of multilevel software is that, while equally convenient and portable as high-level software, it benefits from all the hardware potential. The more sophisticated the hardware, the more interesting the things that can be done with it. My experience with FORTH shows that software-hardware relations should be as tight as possible. (An interesting example of a system (E-machine) with a distributed short-term memory, in which hardware is actually inseparable from software, is described by Victor Eliashberg in "The concept of E-machine and the problem of context-dependent behaviour," TXU 40-302 US Copyright Office, 1980, pages 101 to 112.)■

References

1. FORTH Glossary (compiled by Gregg Williams). BYTE, August 1980, pages 186 through 196.
2. James, J S. "What Is FORTH? A Tutorial Introduction." BYTE, August 1980, pages 100 through 126.
3. Rather, E D and C H Moore. "The FORTH Approach to Operating Systems." *ACM 1976 Proceedings*, October 1976, pages 233 through 240.

PS Glossary

The glossary consists of two parts: stack operations and auxiliary words. The words in the first part are equivalent to their counterparts in FORTH; they are provided for readers not familiar with FORTH.

*The notation used in some definitions should be interpreted similarly to the following example: "*n1 n2 → n3*" means "before the word is executed,* n2 *is on top of the stack and* n1 *is immediately below it; after the word is executed, both* n1 *and* n2 *have been replaced by* n3*." (The values* n1, n2, *and* n3 *are 16-bit data.) This notation says nothing about what (if anything) is under these entries on the stack.*

Stack Operations

DUP — *Duplicates the 16-bit number on top of the parameter stack.*
n1 → n1 n1

DROP — *Drops the number from the top of the stack.*
n1 → *(empty)*

SWAP — *Exchanges the top two numbers on the stack.*
n1 n2 → n2 n1

OVER — *Places the copy of the second number onto the top of the parameter stack.*
n1 n2 → n1 n2 n1

ROT — *Rotates the top three numbers, placing the third one onto the top.*
n1 n2 n3 → n2 n3 n1

+ (add) — n1 n2 → n3, *where* n3 = n1 + n2.

Continued on page 406

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Continued from page 405:

− (subtract), * (multiply), and / (divide) — n1 n2 → n3, *analogous to the word* + , *above.*

AND (logical "and") — n1 n2 → n3, *where* n3 *is the bitwise logical "and" of* n1 *and* n2.

OR (logical "or") — n1 n2 → n3, *where* n3 *is the bitwise logical "or" of* n1 *and* n2.

NOT (logical "not") — n1 → n2, *where* n2 *is the one's complement of* n1.

= (equals) — n1 n2 → f, *where* f *is 0001 if* n1 = n2, *or 0000 otherwise.*

> (greater than) — n1 n2 → f, *where* f *is 0001 if* n1 > n2, *or 0000 otherwise.*

< (less than) — n1 n2 → f, *where* f *is 0001 if* n1 < n2, *or 0000 otherwise.*

@ (fetch) — n1 → n2, *where* n2 *is the 16-bit number held in the bytes at addresses* n1 *and* n1 + *1.*

{ ! } (store) — n1 n2 → *(empty), where the 16-bit number* n1 *is stored at the address* n2. *The numbers* n1 *and* n2 *are removed from the stack after the operation is performed.*

C@ (fetch a character) — n1 → *00*xx, *where* xx *is the 8-bit contents of the address* n1.

{ C! } (store a character) — n1 n2 → *(empty), where the 8 least-significant bits of* n1 *are stored at the address* n2.

{ +! } (plus-store) — n1 n2 → *(empty), where* n1 *is added to the 16-bit number held in the bytes at addresses* n2 *and* n2 + *1.*

KEY — *Waits until the next terminal key is struck and pushes its ASCII code (xx) onto the top of the parameter stack. (empty)* → *00*xx

EMIT — *00*xx →*(empty), where the ASCII equivalent of* xx *is transmitted to the display, the printer, or some other selected output device.*

CR (carriage return) — *The same as 0D EMIT where hexadecimal 0D is the ASCII code for a carriage return.*

Auxiliary Words

[**Editor's Note:** *These words are unique to PS and do not behave as their FORTH equivalents. Like all PS words, these are actually machine-language subroutines that end with a return-from-subroutine instruction. While they are executing, the return stack of the microprocessor being used contains the return address of the current subroutine—in other words, the return address points to the next byte after the call of the PS word being executed. Sometimes, the PS word currently executing will manipulate or use this value....***GW**]

ORIGIN (special word) — *Used as* {ORIGIN nnnn}. *Takes the following word, converts it to a 16-bit number, and sets the code pointer equal to this number.*

# (special word—compiles an 8-bit number) — *Used as* {# nn}. *Converts the following word to a number and pushes its 8 least-significant bits into the code. Increments the code pointer by 1.*

NUMBER — *If the next word read from the input stream starts with a 0 or the minus sign, converts it to a 16-bit integer. In execute mode, pushes this number onto the stack as a parameter. In compile mode, compiles the sequence JSR PSHN* nnnn, *where* nnnn *is the 16-bit converted signed integer.*

PSHN (push number) — *Pushes the contents of the return address (a 16-bit number) into the code and increments the return address by 2. Compiled by NUMBER.*

LINK — *Pushes the value of the V field into the code and sets the V field of the word to the code pointer decremented by 2. Used to link references to an undefined word, as shown in part 1 of the article.*

RESOLVE — *Resolves forward references to the word being defined, sets the type of the word to "defined," and sets the V field of the word equal to the code pointer. Used to store the value of the word being defined into locations where this word has already been referenced.*

: (defines a high-level word) — *Reads the next word, sets IF counter to 0, and switches to compile mode. If the word has been previously used, resolves forward references; if it has not, makes a new dictionary entry. In either case, sets its V field equal to the value of the code pointer and sets the type to "defined."*

; (special word—end of a colon definition) — *Compiles an RTS instruction, switches to execute mode, verifies that the control structures are balanced—that the IF counter is equal to 0—and generates an error message if it is not.*

:: (defines a special word) — *Reads the next word, sets IF counter to 0, switches to compile mode, makes a new entry in the dictionary for the word, sets its T (type) field to "special," sets its V (value) field to the value of the code pointer.*

IF (special word) — *Increments the IF counter, compiles the instruction JSR IFNOT, pushes the value of the current code pointer onto the computer stack, pushes a temporary dummy address of 0000 into the code.*

IFNOT — *If the top of the parameter stack is 0, jumps to the address specified by the 2 bytes pointed to by the return address. Otherwise, increments the return address by 2 and returns. Compiled by IF and UNTIL.*

ELSE (special word) — *Checks that the IF counter is greater than 0, compiles JMP 0000, stores the value of the code pointer into the 2-byte location pointed to by the address on the top of the stack (left by the previous IF statement), and pushes the code pointer decremented by 2 onto the computer stack.*

ENDIF (special word) — *Checks that the IF counter is greater than 0, decrements it, and stores the code pointer into the 2-byte location pointed to by the address on the top of the stack (left by the previous IF or ELSE statement).*

BEGIN (special word) — *Increments the IF counter and pushes the value of the code pointer onto the computer stack.*

AGAIN (special word) — *Verifies that the IF counter is greater than 0, decrements it, compiles a JMP instruction, and pushes the address from the computer stack (left there by the previous BEGIN) into the code.*

UNTIL (special word) — *Verifies that the IF counter is greater than 0, decrements it, compiles JSR IFNOT, and pushes the address from the computer stack (left by the previous BEGIN) into the code.*

DO (special word) — *Used as {* n m *DO ... LOOP }, with the initial value of the index* n *and loop limit* m*. Compiles the instruction JSR RUN.TIME.DO (which pushes* n *and* m *at run time from the parameter stack onto the computer stack), pushes the code pointer onto the computer stack, and increments the IF counter.*

RUN.TIME.LOOP — *Increments* n *(see the previous definition). If* n = m *(both numbers are on the computer stack), increments the return address by 2 and returns. If* n < m, *jumps to the address specified by the 2 bytes pointed to by the return address. Compiled by LOOP.*

LOOP (special word) — *Checks that the IF counter is greater than 0, decrements it, compiles JSR RUN.TIME.LOOP, and pushes the address from the computer stack (left by the previous DO) into the code.*

LABEL (special word) — *Reads the next word. If the word has been previously used, resolves forward references; if it has not, makes a new dictionary entry. In either case, sets its V field to the value of the code pointer and sets the type to "defined."*

— > (special word) — *Reads the next word and pushes a JMP instruction into the code. If the word is undefined but previously used, links this forward reference to the previous ones. If it is a new word, makes an entry, sets the type to "undefined," sets the V field to the value of the code pointer, and pushes 0000 into the code. If it is a defined word, pushes*

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Continued from page 407:

the value of the V field into the code.

PSHN (push number) — *Pushes the contents of the return address (16-bit data) onto the parameter stack and drops the return address from the computer stack. Compiled by CONST.*

PSH8 (push 8-bit data) — *The same as PSHN, but an 8-bit quantity is pushed onto the parameter stack and drops the return address from the computer stack. Compiled by BCONST.*

PSHA (push address) — *Pushes the return address onto the parameter stack and drops the return address from the computer stack. Compiled by VAR.*

VAR (variable) — *Used as { VAR <name>* nnnn *} or { VAR <name> #* nn *}. Reads the next word. If it has been previously used, resolves forward references; if it has not, makes a new dictionary entry. In either case, sets the type to "defined," sets its V field to the value of the code pointer, and compiles the instructions JSR PSHA.*

CONST (constant) — *Used as { CONST <name>* nnnn *}. Reads the next word. If it has been previously used, resolves forward references; if it has not, makes a new dictionary entry. In either case, sets the type to "defined," sets its V field to the value of the code pointer, and compiles the instructions JSR PSHN.*

BCONST (byte constant) — *Used as { BCONST <name> # nn }. Reads the next word. If it has been previously used, resolves forward references; if it has not, makes a new dictionary entry. In either case, sets the type to "defined," sets the V field to the value of the code pointer, and compiles the instructions JSR PSH8.*

ARRAY — *Used as { ARRAY <name>* nnnn *}. Reads the next word. If it has been previously used, resolves forward references; if it has not, makes a new dictionary entry. In either case, sets the type to "defined," sets the V field equal to the value of the code pointer, compiles the instructions JSR PSHA, reads the next word, converts it to a number, and increments the code pointer by this number.*

{ " } **(special word)** — *Reads the text from the input stream until another quote is hit and compiles the following: <byte count> <the string of characters just entered>.*

TYPE.STRING — *Types a string located at the return address and increments the return address by the byte count plus 1 and returns. This word is compiled by the word "dot-quote" ({ ." }) before <byte count> <string>.*

." (special word) — *Reads the text from the input stream until a quote (") is hit. If PS is in execute mode, types the string— that is, sends it to the printer or other display device. If PS is in compile mode, compiles the instructions JSR TYPE.STRING <byte count> <string> (this will type the string at run time). An example is { ." IMMEDIATELY PRINT THIS SENTENCE" }.*

{ [} **(special word)** — *Sets the system variable MODE.FLAG to 00 to signal that the system is now in the execute mode.*

{] } **(special word)** — *Sets the system variable MODE.FLAG to 01 to signal that the system is now in the compile mode.*

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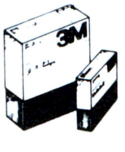

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Languages Forum

A View from the Lectern: What's Wrong with Technical Writing Today?

Dr Carol Barnum
Department of English and History
Southern Technical Institute
Marietta GA 30060

Last year, BYTE Editor in Chief Chris Morgan spoke out on the topic "What's Wrong with Technical Writing Today?" (December 1980 BYTE, page 6). As a technical writer and, more importantly, as a professor of technical writing at a four-year engineering-technology college, I read his editorial with a great deal of interest and agreement. What follows is a view from the lectern: in other words, what's wrong with technical writing today as I see it from the college classroom.

Morgan's Laws

Everything that Mr Morgan mentioned as essential to technical writing is in the typical college-level technical writing course. What Mr Morgan calls "knowing your audience" instructors call "audience analysis." What Mr Morgan calls his Laws comprise the fundamentals for any technical writing text, except that he expresses them with a great deal more succinctness and humor than do most textbooks. While I agree wholeheartedly with his Laws, I'll expand on them a bit before addressing the central question of his editorial.

Morgan's Law #1: No Writer Ever Got Shot Down for Writing Too Clearly. Corollary 1.1: Nor Did Any Writer Ever Get Shot Down for Writing Too Simply. Many people falsely think that they need to sound erudite and learned (read "pompous and unintelligible") for fear of being pedestrian and primitive (read "clear and concise"). All too often writing is peppered with fancy five-dollar words when the simple fifty-cent variety does the job more effectively. We can talk about "readability formulas," and there are several (including those of Rudolf Flesch and Robert Gunning), but all they do is show the writer whether he is writing on a level that bypasses most of his readers.

Morgan's Law #2: The Beginning is Half the Thing. Corollary 2.1: The Summary is the Major Thing. While it

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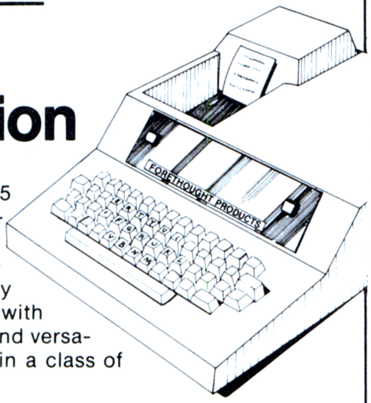

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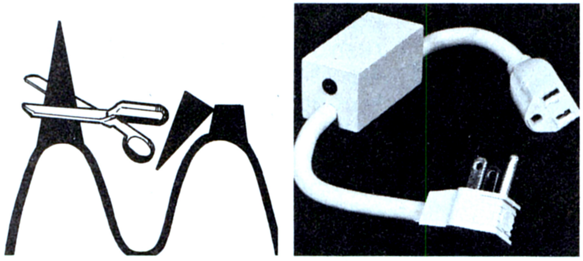

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only represents one-tenth or less of the report, it contains the seeds of the entire work, including the conclusion or recommendation, if one is required. Everyone reads the summary; then the audience picks and chooses what it needs from the rest of the report. Yet how many technical reports, memos, or articles contain that essential summary up front where it belongs? And how many times have you had to wade through the entire report to see what the results are?

Morgan's Law #3: Avoid the Penguin Syndrome. (Tell your readers what they need to know, and no more.) Corollary 3.1: Then Use Appropriate Headings to Tell Them What to Expect. These are, or should be, the road markers to the report or article. Their purpose is to let your reader know *before* he reads your report what information is contained in each section and whether that information is important to him. Many reports have headings but few have enough to keep the reader on course.

Morgan's Law #4: Writing is Nonlinear. (Absolutely.) Corollary 4.1: Who *really* writes an outline? I don't, and I suspect that many others who write don't either. But everyone is afraid to admit it, thinking his writing will be labeled disorganized if he doesn't have a clearly planned outline before he writes. Case in point: I'm presently typing this article as the thoughts come to me. Sure, I'm using Mr Morgan's article as a starting point (in much the same way that one might use data or research or personal experience in writing), but beyond the notion that I have something to say, I'm not sure yet how it will all get said or where it will end up. Later, I will surely cut and paste, taking out some parts and expanding others, but the piece will remain essentially as it is, which confirms Morgan's Law #4.

Very few people know exactly where they're going until they get going; then the road bends and curves and they steer along it following the natural turns. Yet almost all the textbooks include and emphasize outlining (the highly structured, traditional kind) as the way to plan one's technical writing. True, one needs some sense of direction or purpose in writing, but the first draft should be given a mind of its own.

Morgan's Law #5: (The Three Foot Rule): Don't Write Anything Unless You have a Dictionary and a Thesaurus Within Three Feet of You. Corollary 5.1: Having Them Nearby Is the First Step; Using Them is the Second. Proximity of reach does not guarantee use.

Corollary 5.2: Use the Thesaurus with Caution. You must know the word you're substituting another word for. Otherwise, how can you be sure the substituted word is an accurate synonym? Keep in mind, too, that the thesaurus is more often abused than correctly used. Some writers like to "upgrade" their vocabulary, picking out fancy-sounding words for the perfectly simple and clear ones. You might try substituting a good handbook of grammar for the thesaurus and make that your number two source book.

Morgan's Law #6: Don't Be Afraid to Be Interesting. No addendum needed!

What's Wrong with Technical Writing?

With Morgan's Laws as a reference point, I'll now address, from a classroom perspective, Mr Morgan's initial question—What's Wrong With Technical Writing Today?

What's basically wrong is that students aren't interested in technical writing—at least not while they're students. What they *are* interested in is technology and science and computers and engineering. BYTE and *Omni* sell out each month in the campus bookstore, and issues of the student newspaper focus on different technical problems—such as the environment, economics, alternate energy sources, and nuclear power. But students hate to write, they cannot write well or easily, and they think they'll never have to write in "the real world." Their favorite line is: "Why do I need to know grammar or how to spell? My secretary will take care of all that."

Today's Technical Students

Technical students are very curious about things mechanical and mathematical, but they hate and are afraid to put pen to paper. They have good reason for both emotions. Instead of encouraging good writing most high schools, unknowingly, do the opposite. In the permissive 1970s, the schools stopped requiring English courses beyond the ninth grade or adopted "creative" writing courses that asked students to *emote* rather than *denote*. These touch-and-feel creative seminars ignored discrepancies in grammar, syntax, and spelling for fear of alienating the student. And students do not read. Their vocabularies are limited by their exposure to television and rock music.

When these students reach college, they're knocked out of their chairs during the first week of Freshman Composition (FC) with Fs on their papers for all the things they were never told or didn't bother to remember in high school. Other students don't make it directly to FC but must first master remedial programs, from which only a limited number escape. Those who do and then survive FC move into the upper levels of academe, where they take Technical Writing along with other technical courses. At this point, the students feel even less sure of their writing abilities and less willing to believe that they'll ever need to do anything so abhorrent as write memos, articles, and reports.

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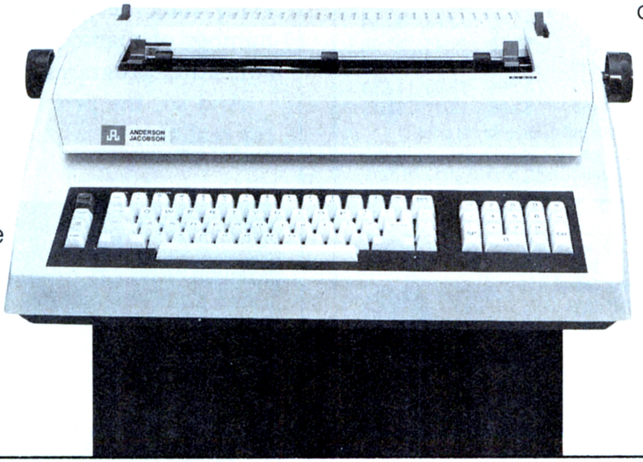

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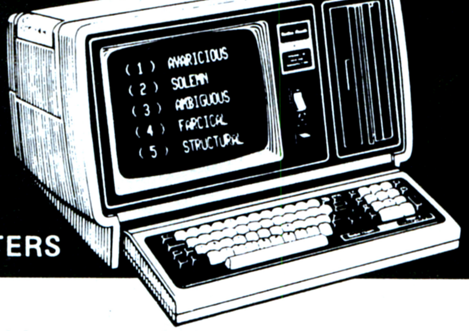

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Languages Forum

In the Classroom

So what happens in the classroom? Not much until the first papers are returned. In my technical writing class, I spend the first three weeks talking about the language and style of technical writing, the types, the methods of organization based on proper audience analysis, and the need for conciseness in writing and meticulousness in editing and proofreading. I entertain with examples of horrid writing, I instruct with handouts of organizational patterns, and I inform with case problems which students work in class and which we then discuss. Finally, they write their first report. Almost all fail.

Now they want to listen, but not for the value that such information will provide in their future careers. Rather, they listen so that they can make the grade that will get them *out* of the course. And in the evaluations that I receive at the end of the quarter, they repeatedly complain that I require too much work for a three-hour course.

Teacher as Missionary

I, of course, pay no attention to my students' complaints, for I'm on a mission of sorts. I have them for only one quarter and then for only three hours a week for ten weeks. After they leave my class and the college, they will become the engineers and technologists of the future. They will build the technologies that I will use. They will implement the plans; they will set the procedures. And their efforts, their knowledge, their expertise is only as good as their ability to express it accurately and effectively and clearly to others. They don't know that, but I do. And that's the problem with technical writing today, as I see it.

Later, the students—now employees of companies and/or employers—discover this fact for themselves. They *do* have to write on the job—more than they realized or feared. But they don't have the skills to do the job well, and they can't remember what they learned in college because it didn't matter then. Some companies—more and more—recognize the problem and hire consultants to set up seminars to teach their people the skills they need. Others send them to an increasing number of management writing courses and continuing education programs.

And so, the process begins again. Only this time, it's for real. ■

Languages Forum is a feature which is intended as an interactive dialog about the design and implementation of languages for personal computing. Statements and opinions submitted to this forum can be on any subject relevant to its purpose of fostering discussion and communication among BYTE readers on the subject of languages. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.

Circle 298 on inquiry card.

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Technical Forum

Where Am I? A Proposal for a New Microprocessor Instruction

Dr S S Reddi, 1000 W MacArthur #49, Santa Ana CA 92707

Few contemporary computers provide a single explicit instruction that returns its present location in memory. It is possible to find the address where an instruction is located by making a subroutine call and popping up the stack register, but this may require more than three instructions. When executed, a WAI (Where Am I?) instruction could leave the value of the PC (program counter) in the accumulator. Digital Equipment Corporation's VAX 11/780, which treats the PC as one of its registers, allows moving the value in the PC with the MOVE instruction, but the result is unpredictable. This is possibly due to the look-ahead feature it employs, and a similar situation could arise in computers that use pipelining.

With a WAI instruction, I could write relocatable machine code more easily on my Apple II. When I write a machine-language program starting at address 300 (hexadecimal) and need to store data (without using the stack facility) or refer to a subroutine starting 60 bytes after the starting address, the code no longer becomes relocatable, for, obviously, one has to use statements like JSR $#360, and this code cannot be located starting at, say, 400. (As mentioned before, one can implement WAI by making a subroutine call and using the stack pointer—this is the solution proposed in the *Apple Reference Manual*). Also, when circuit cards containing relocatable code in ROM (read-only memory) are plugged into one of the Apple's slots, they may need to know where they have been installed—without the user intervening—so that they may place appropriate address values in proper processor memory locations.

There must be a reason for the absence of this instruction. I hope other BYTE readers will present pros and cons for this instruction based on their hardware and software experience.■

Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.

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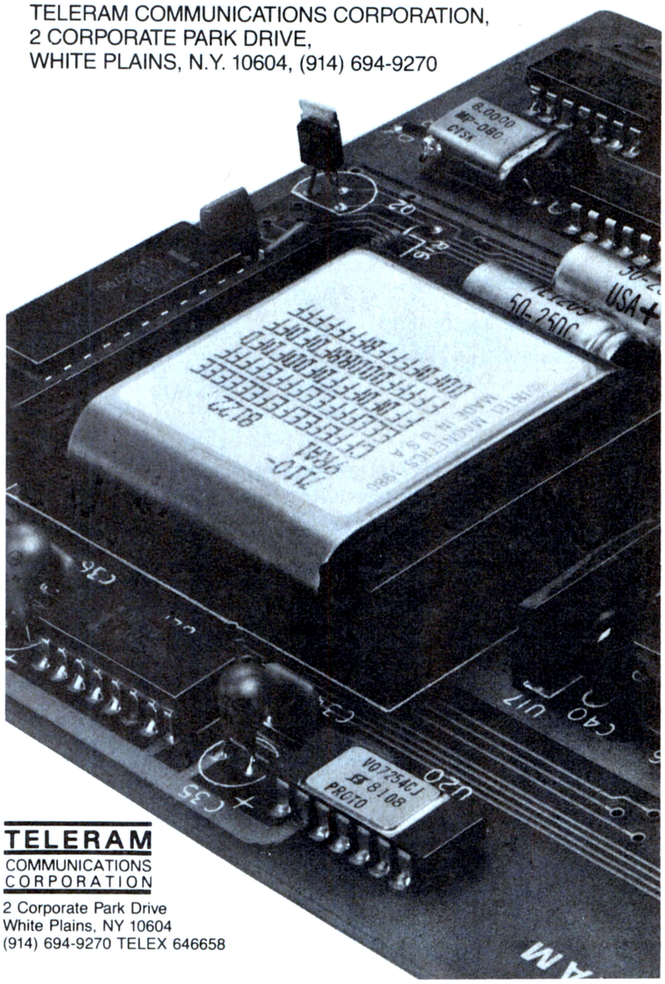

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Programming Quickies

WRITELONG

A Pascal Simulation of Long-Integer Output

Daniel S Hunt
822 Green Valley
Newbury Park CA 91320

Imagine you are programming output for a spread sheet. Wishing to depict the product-by-product sales of apples, oranges, and pears in an analysis of monthly sales of S & S Fruit Stands Inc, you write in Pascal:

```
for i := jan to dec do
    write(round(apples[i]):10);
```

But S & S is a big company. Their monthly sales exceed the maximum integer possible in the target processor, which is 16 bits (the range −32768 to 32767). So the program crashes if you use the round function. If you don't use the round function, your output shows apple sales with a decimal point followed by zero, as in 55,765.0 apples.

Procedure WRITELONG will solve the problem if the Pascal version used does not have long integer conversion. As input it accepts a real number, "x", and a field-length specification, "flen". It splits the real number into two parts. A division and truncation, followed by re-multiplication and subtraction from the original number, isolates the right part of the number from the left.

For a 6.5-digit precision floating-point number, the right part is fixed at three digits. If rounding of the right part yields a number longer than three digits, overflow is carried into the left (atrunc := atrunc + 1), and the right is reset. Occurrence of zeroes in the right part is filled in an *if...then...else* sequence that evaluates number ranges. For greater precisions, the right part could be extended to four digits, along with the *if...then...else* sequence.

The banishing of the decimal point has other possible solutions. A real-to-string conversion routine may prove more useful if you wish to position commas in the output. WRITELONG, however, has one small advantage: the algorithm depends upon neither the host processor nor a specific implementation of Pascal. ■

Circle 371 on inquiry card.

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Listing 1: *Example of an application of the WRITELONG procedure in Pascal.*

```
program longtest;
var
    flen : integer;     {format field width}
    x : real;           {real 6.5-digit num}
    f : text;           {text file for i/o }
    s : string;         {file / device name}


procedure writelong(x : real; flen : integer);

var
    areal, breal : real;         {left and right parts of x }
    atrunc, brnd : integer;      {integerized parts of x    }

begin
    if x <= 32767.0 then         {MAXINT - 1}
        write(f,round(x):flen)
    else
        begin

           {get trunc of left part}
           areal := x / 1000.0;
           atrunc := trunc(areal);

           {get round of right part}
           areal := 1000.0 * atrunc;
           breal := x - areal;
           brnd := round(breal);

           if brnd > 999 then
              begin
                 {carry overflow to left}
                 atrunc := atrunc + 1;
                 {reset right}
                 brnd := brnd - 1000
              end;

           {write left part}
           write(f,atrunc:(flen-3));

           {fill and write right part}
           if brnd >= 100 then
               write(f,brnd)
           else
               if (brnd >= 10) and (brnd <= 99)
                  then write(f,'0',brnd)
           else
               if (brnd >= 1) and (brnd <= 9)
                  then write(f,'00',brnd)
           else
               write(f,'000');
        end;{>32767}

end; {writelong}



begin
 s := 'CON:';    {filename - CPM output to console}
 assign(f,s);    {Pascal MTPLUS fcb assignment     }
 rewrite(f);

 writeln;
 writeln('LONG INTEGER FORMAT OF REAL NUMBER');
 repeat
   write(f,'Enter X ');
   readln(x);
   write('Format length ');
   readln(flen);

   writeln(f,'SCALE:');
   writeln(f,'123456789x123456789x123456789x');
   writelong(x,flen);
   writeln(f);
 until x < 1.0;
end.
```

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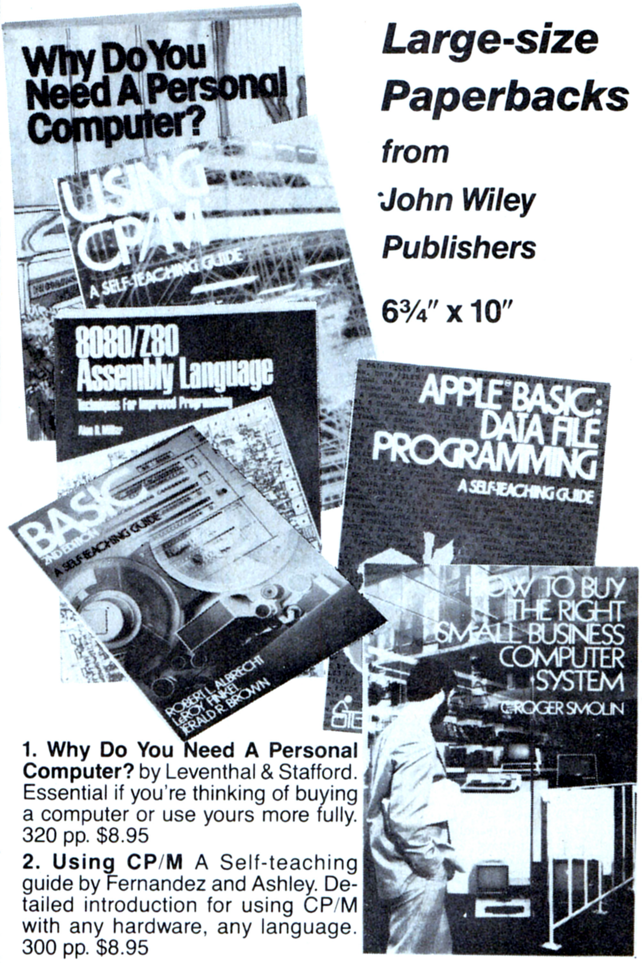
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Listing 1 continued from page 95:

```
0370    EB          @        XCHG            ;
0371    E9          @        PCHL            ;JMP TO EVENT PRGM
                    @;
                    @;
                    @;
                    @;*********************************************
                    @;
                    @;OVERFLOW ROUTINE:  DISABLES INTERRUPTS AND
                    @;CLOCK, OUTPUTS MESSAGE TO CONSOLE AND RETURNS
                    @;
                    @;
                    @;
0372    F3          @OVFLOW: DI              ;DISABLE INTERRUPTS
0373    3E40        @        MVI     A,40H   ;DISARM SYSTEM CLOCK
0375    D306        @        OUT     6       ;
0377    21 037E     @        LXI     H,..MESS;
037A    CD 047A     @        CALL    MESSOUT ;SEND MESSAGE
037D    C9          @        RET
                    @;
037E                @..MESS: .ASCIZ  /
037E    0D0A        @
0380    0D0A092A2A2A@        ***************************************
03A9    0D0A        @
03AB    0D0A0953414D@        SAMPLING ABORTED:   PROCESSOR TOO SLOW!
03D4    0D0A09090920@                            BUFFER OVERFLOW !!!
03EF    0D0A        @
03F1    0D0A092A2A2A@        ***************************************
041A    0D0A        @
041C    0D0A00      @/
                    @;

                             .INSERT B:FNXN
                    @;      ****************
                    @;      *              *
                    @;      *    FNXN      *
                    @;      *              *
                    @;      ****************
                    @;
                    @;THIS SR TAKES A 16-BIT NUMBER AND DIVIDES
                    @;IT BY 2*(REG A) NUMBER OF TIMES. ON ENTERING,
                    @;THIS SR EXPECTS HL TO POINT TO THE LOW BYTE
                    @;OF THE 2-BYTE NUMBER.  HIGH BYTE IS ASSUMED
                    @;TO BE AT (HL+1).  RETURN IS MADE WITH HL
                    @;POINTING TO THE LOW BYTE.  SIGN BIT OF LOW
                    @;BYTE IS COMPLEMENTED BEFORE RETURN.
                    @;
041F    B7          @FNXN:   ORA     A       ;PR CODE=0?
0420    2809        @        JRZ     ..CMPL
0422    23          @..LOOP: INX     H       ;
0423    CB3E        @        SRLR    M       ;DIVIDE BY TWO
0425    2B          @        DCX     H       ;
0426    CB1E        @        RARR    M       ;
0428    3D          @        DCR     A       ;
0429    20F7        @        JRNZ    ..LOOP  ;DIVIDE AGAIN?
042B    7E          @..CMPL: MOV     A,M     ;COMPL SIGN BIT
042C    EE80        @        XRI     128D    ;
042E    77          @        MOV     M,A     ;
042F    C9          @        RET
                    @;

                             .INSERT B:S$INIT
                    @;**************************************
                    @;*                                    *
                    @;*   SAMPLING INITIATOR               *
                    @;*                                    *
                    @;**************************************
                    @;
                    @;THIS ROUTINE INITIALIZES THE INTERRUPT
                    @;HANDLER, CLEARS THE TEMP BUFFERS, SETS
                    @;UP THE APPROPRIATE COUNTERS, ENABLES
                    @;INTERRUPTS AND THEN RETURNS. THE INTRRPT
                    @;VECTOR JAMMED ONTO THE BUS IS PRESUMED TO
                    @;BE OFFH.
                    @;
                    @;REGISTERS ARE NOT PRESERVED.
                    @;
                    @;WHEN CALLLED, THIS SR EXPECTS REGS DE
                    @;TO CONTAIN THE STARTING ADDR OF A TABLE
                    @;CONTAINING THESE PARAMETERS IN THIS
                    @;ORDER:
                    @;;
                    @;BYTE 0 :# CHANNELS TO SAMPLE (STARTING
                    @;               AT 030Q)
                    @;BYTE 1 :# INTERRUPTS PER SAMPLE
                    @;BYTE 2 :# SAMPLES PER DATA POINT
                    @;
0430    D5          @INIT:   PUSH    D       ;TRANSFER PARAMETERS
0431    E1          @        POP     H       ;TO INTERNAL LOC
0432    11 0137     @        LXI     D,CHNL  ;
0435    EDA0        @        LDI             ;CHNL
0437    EDA0        @        LDI             ;# INTRPTS/SAMPLE
0439    EDA0        @        LDI             ;# SAMPLES/DATA PT
043B    2B          @        DCX     H       ;INITIALIZE SAMPLE CNTR
```

Listing 1 continued:

```
043C    EDA0       @        LDI             ;
                   @;
043E    D9         @        EXX             ;SET UP INTRPT CNTR
043F    3A 0138    @        LDA     INT$S   ;
0442    47         @        MOV     B,A     ;
0443    D9         @        EXX             ;
                   @;
0444    2A 0183    @        LHLD    NTMPAD  ;INITIALIZE BUFFERS
0447    0620       @        MVI     B,32D   ;WITH 00
0449    3E00       @        MVI     A,0     ;
044B    77         @..LOOP: MOV     M,A     ;LOOP TILL DONE
044C    23         @        INX     H       ;
044D    10FC       @        DJNZ    ..LOOP  ;
                   @;
                   @;SET UP INTERRUPT JUMP ADDRESS.  ASSUMES CLOCK
                   @;FLAG JUMPERED TO VI3.
                   @;
044F    ED46       @        IM0             ;INTRPT MODE = 2
0451    21 0018    @        LXI     H,18H   ;FILL IN JMP INSTR
0454    3EC3       @        MVI     A,0C3H  ;
0456    11 018E    @        LXI     D,INTHLD;
0459    77         @        MOV     M,A     ;
045A    23         @        INX     H       ;
045B    73         @        MOV     M,E     ;
045C    23         @        INX     H       ;
045D    72         @        MOV     M,D     ;
045E    3E50       @        MVI     A,50H   ;RESET CLOCK FLAG
0460    D306       @        OUT     6       ;
0462    3EC0       @        MVI     A,0C0H  ;ARM CLOCK INTRPT
0464    D306       @        OUT     6       ;
0466    FB         @        EI              ;ENABLE INTERRUPTS
0467    C9         @        RET             ;AND RETURN
                   @;
                            .INSERT B:P$INIT
                   @;****************************************
                   @;*                                      *
                   @;*       PROCESSOR INITIALIZER          *
                   @;*                                      *
                   @;****************************************
                   @;
                   @;ON ENTRY, THIS SR EXPECTS REG DE TO CONTAIN
                   @;THE STARTING ADDRESS OF A TABLE CONTAINING, IN
                   @;THIS SEQUENCE:
                   @;
                   @; BYTE  0       PROCESS CODE (USED BY "FNXN" TO
                   @;               DETERMINE HOW MANY HALVINGS TO
                   @;               DO
                   @;
                   @; BYTE  1       # OF PROGRAMMED EVENTS
                   @;
                   @; BYTES 2,3     TIME FOR EVENT #1 (#DATA PTS)
                   @;
                   @; BYTES 4,5     ADDR OF PRGM EXECUTING EVENT #1
                   @;
                   @; BYTES 6,7     TIME FOR EVENT #2
                   @;
                   @; BYTES 8,9     ADDR OF PRGM EXECUTING EVENT #2
                   @;
                   @; ...ETC... FOR ALL EVENT TIMES AND PRGM ADDR'S
                   @;
                   @;
                   @;REGISTERS ARE NOT PRESERVED;
                   @;PARAMETERS FROM THE TABLE ARE INSERTED BY THIS
                   @;ROUTINE INTO INTERNAL LOCATIONS OF PROCSR
                   @;FOR APPROPRIATE DATA PROCESSING AND TIMING
                   @;FUNCTIONS.
                   @;
0468    D5         @P$INIT: PUSH    D       ;TRANSFER PARAMETERS
0469    E1         @        POP     H       ;TO INTERNAL TABLES
046A    11 013B    @        LXI     D,DIVSR;
046D    EDA0       @        LDI             ;PROCESS CODE
046F    7E         @        MOV     A,M     ;
0470    EDA0       @        LDI             ;N$EVTS
0472    87         @        ADD     A       ;FORM BYTE COUNTER
0473    87         @        ADD     A       ;  (=4*N$EVTS)
0474    0600       @        MVI     B,0     ;PUT IN BC
0476    4F         @        MOV     C,A     ;
0477    EDB0       @        LDIR            ;TRANSFER TIMES AND
                   @                        ;ADRR'S FOR ALL EVENTS
0479    C9         @        RET             ;
                            .INSERT B:MESSOUT
                   @;**********************************
                   @;*                                *
                   @;*          MESSOUT               *
                   @;*                                *
                   @;**********************************
                   @;
                   @;THIS SUBROUTINE OUTPUTS A MESSAGE TO THE
                   @;CONSOLE USING THE DOS 'COUT' ROUTINES AND
                   @;RETURNS CONTROL TO THE CALLING PROGRAM.
                   @;THE SUBROUTINE EXPECTS HL TO HOLD THE
```

Listing 1 continued on page 418

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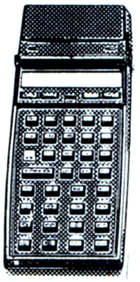

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Listing 1 continued:

```
                    @;ADDRESS OF THE MESSAGE WHICH MUST BE
                    @;TERMINATED BY A NULL CHARACTER.
                    @;REGISTERS A,B,H,L ARE ALTERED IN THIS
                    @;ROUTINE.
                    @;
                    @;SYMBOL TABLE:
                    @;
200D                @COUT = 200DH
                    @;
                    @;
047A    7E          @MESSOUT:MOV     A,M     ;GET CHARACTER
047B    B7          @        ORA     A       ;NULL CHARACTER?
047C    C8          @        RZ              ;YES,RETURN
047D    47          @        MOV     B,A     ;B<=A
047E    3E00        @        MVI     A,00    ;CLEAR ACC
0480    CD 200D     @        CALL    COUT    ;NO, OUT TO CRT
0483    23          @        INX     H       ;INCR POINTER
0484    C3 047A     @        JMP     MESSOUT ;LOOP TILL NULL

                             .INSERT B:DATWR
                    @;***************************************
                    @;**                                   **
                    @;**             DATWR                 **
                    @;**                                   **
                    @;***************************************
                    @;
                    @;THIS ROUTINE WRITES DATA OUT TO DISK 1 USING
                    @;THE PREVIOUSLY ESTABLISHED POINTERS OF THE
                    @;UTILITY PROGRAMS "PROCSR" AND "INTHDLR".
                    @;IT PLACES #CHANNELS AND #DATA POINTS AT THE
                    @;BEGINNING OF THE FILE (E.G. #CHNLS IN 0FFD;
                    @;BUFFER STARTS AT 1000H).
                    @;
                    @;AFTER WRITING OUT THE FILE (USING "FWRITE")
                    @;THIS SR REINITIALIZES THE POINTERS AND
                    @;INCREMENTS BYTE 8 OF THE FILENAME.  INTRRPTS
                    @;ARE DISABLED ON ENTERING THIS SR AND SHOULD
                    @;BE ENABLED AFTER RETURN IF NECESSARY.
                    @;
                    @;CLOCK FLAG IS CLEARED BEFORE RETURN.
                    @;ONLY THE IX AND IX REGISTERS
                    @;ARE PRESERVED.
                    @;
0487    F3          @DATWR:  DI              ;STOP INTERRUPTS
0488    2A 017F     @        LHLD    MBUFPT  ;CALCULATE #DATA PTS +3
048B    ED5B 017D   @        LDED    BFSTRT  ;
048F    1B          @        DCX     D       ;
0490    1B          @        DCX     D       ;
0491    1B          @        DCX     D       ;
0492    B7          @        ORA     A
0493    ED52        @        DSBC    D       ;
0495    E5          @        PUSH    H       ;SAVE FILE SIZE
0496    2B          @        DCX     H       ;CALCULATE #DATA PTS
0497    2B          @        DCX     H       ;
0498    2B          @        DCX     H       ;
0499    EB          @        XCHG            ;HL <= [BFSTRT] -3
                    @                        ;DE <= #DATA PTS
049A    3A 0137     @        LDA     CHNL    ;STORE #CHNL
049D    77          @        MOV     M,A     ;
049E    23          @        INX     H       ;
049F    72          @        MOV     M,D     ;STORE HIGH BYTE OF
04A0    23          @        INX     H       ;#DATA POINTS
04A1    73          @        MOV     M,E     ;STORE LOW BYTE OF
                    @                        ;#DATA POINTS
04A2    2B          @        DCX     H       ;
04A3    2B          @        DCX     H       ;
04A4    EB          @        XCHG            ;
04A5    E1          @        POP     H       ;HL <= #DATA PTS +3
                    @                        ;DE <= [BFSTRT] -3
                    @                        ;NOW CALCULATE #BLOCKS:
04A6    7D          @        MOV     A,L     ;
04A7    B7          @        ORA     A       ;
04A8    2801        @        JRZ     ..NOAD  ;

04AA    24          @        INR     H       ;
04AB    4C          @..NOAD: MOV     C,H     ;BC<=#BLOCKS
04AC    0600        @        MVI     B,0     ;
04AE    3E01        @        MVI     A,1     ;SPECIFY DISK #1
04B0    21 0185     @        LXI     H,FLNAME;HL<=ADDR OF FLNAME
                    @        ;
04B3    CD 04C5     @        CALL    FWRITE  ;WRITE DATA
                    @        ;
                    @        ;
04B6    21 018C     @        LXI     H,FLNAME+7 ;UPDATE
04B9    34          @        INR     M            ;FLNAME
04BA    2A 017D     @        LHLD    BFSTRT  ;UPDATE BUFFER PTR
04BD    22 017F     @        SHLD    MBUFPT  ;
04C0    3E50        @        MVI     A,50H   ;RESET CLOCK FLAG
04C2    D306        @        OUT     6       ;
04C4    C9          @        RET             ;RETURN
                    @;
```

Listing 1 continued:

```
                              .INSERT B:FWRITE
                    @;*************************************
                    @;*                                   *
                    @;*            FWRITE                 *
                    @;*                                   *
                    @;*************************************
                    @;
                    @;SUBROUTINE TO WRITE A FILE ONTO DISK
                    @;UNIT #1 OR 2 USING DOS I/O ROUTINES.
                    @;  EXPECTS:
                    @;
                    @;        A  = FILE DRIVE # (1 OR 2)
                    @;        DE = STARTING RAM ADDR OF FILE
                    @;        BC = # OF BLOCKS
                    @;        HL = ADDR OF FILE NAME
                    @
                    @;FILENAME MUST CONSIST OF 8 ALPHANUMERIC
                    @;CHARACTERS FOLLOWED BY A BLANK (ASCII 20).
                    @;
                    @;REGISTERS ARE NOT PRESERVED.
                    @;
                    @;SYMBOL TABLE:
                    @;
201C                @DLOOK = 201CH    ;DOS FILE DIRECTORY LOOKUP
201F                @DWRIT = 201FH    ;DOS DIRECTORY ENTRY WRITE
2022                @DCOM  = 2022H    ;DOS DISK COMMAND SR
2028                @DOS   = 2028H    ;DOS ENTRY PT
                    @;
04C5    D5          @FWRITE:  PUSH    D       ;STARTING RAM ADDR
04C6    C5          @         PUSH    B       ;# BLOCKS
04C7    C5          @         PUSH    B       ;
04C8    E5          @         PUSH    H       ;FILE NAME ADDR
                    @;
04C9    CD 201C     @         CALL    DLOOK
04CC    D2 050D     @         JNC     TAKEN   ;IF FILE NAME TAKEN
04CF    E5          @         PUSH    H       ;DISK ADDR
04D0    DDE1        @         POP     X       ;ONTO IX
04D2    21 050C     @         LXI     H,BLANK ;BLANK FILENAME
04D5    CD 201C     @         CALL    DLOOK   ;BYTE 8 OF DOS ENTRY
                    @                         ;RETURNED IN (HL)
04D8    DA 055F     @         JC      FULL    ;IF DISK FULL
                    @;
                    @;COPY FILE NAME, DISK ADDRESS AND #BLOCKS
                    @;TO DIRECTORY ENTRY
                    @;
04DB    01 FFF8     @         LXI     B,-8D   ;SUBTRACT 8
04DE    09          @         DAD     B       ;FROM HL
04DF    D1          @         POP     D       ;ADDR OF FILE NAME
04E0    EB          @         XCHG            ;* DE=ADDR OF DOS ENTRY
                    @                         ;* HL=ADDR OF FILE NAME
04E1    01 0008     @         LXI     B,8D    ;PLACE 8 IN BC
04E4    EDB0        @         LDIR            ;COPY FILE NAME
04E6    EB          @         XCHG            ;HL=DOS ENTRY ADDR
04E7    DDE5        @         PUSH    X       ;COPY DISK ADDR
04E9    D1          @         POP     D

04EA    73          @         MOV     M,E
04EB    23          @         INX     H
04EC    72          @         MOV     M,D
04ED    23          @         INX     H
04EE    C1          @         POP     B       ;COPY # BLOCKS
04EF    71          @         MOV     M,C
04F0    23          @         INX     H
04F1    70          @         MOV     M,B
04F2    23          @         INX     H
04F3    3600        @         MVI     M,0     ;COPY FILE TYPE
04F5    23          @         INX     H
04F6    70          @         MOV     M,B     ;COPY TYPE DEP. INFO
04F7    23          @         INX     H
04F8    71          @         MOV     M,C
                    @;
04F9    CD 201F     @         CALL    DWRIT   ;COPY ENTRY TO DISK
                    @;
                    @;SET UP REGISTERS FOR DCOM:
                    @;
04FC    C1          @         POP     B       ;PUT # BLOCKS
04FD    79          @         MOV     A,C     ;INTO ACCUMULATOR
04FE    01 0001     @         LXI     B,1     ;COMMAND=WRITE
                    @                         ;DISK UNIT = 1
0501    D1          @         POP     D       ;STARTING RAM ADDR
0502    DDE5        @         PUSH    X       ;MOVE DISK ADDR
0504    E1          @         POP     H       ;INTO HL
                    @;
0505    CD 2022     @         CALL DCOM       ;WRITE FILE
0508    DA 0532     @         JC      ILLARG  ;CARRY SET=ILLEGAL ARG
050B    C9          @         RET
                    @;
                    @;
050C    20          @BLANK:   .ASCII  / /
                    @;
050D    21 0516     @TAKEN:   LXI     H,..MESS;SEND MESSAGE TO CONSOLE
```

Listing 1 continued on page 420

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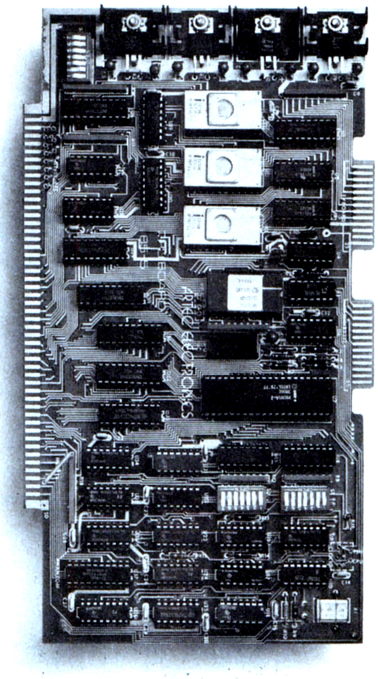

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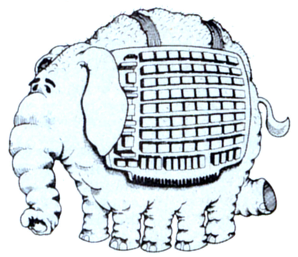

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Listing 1 continued:

```
0510        CD 047A     @        CALL     MESSOUT
0513        C3 2028     @        JMP      DOS
0516        46494C45204E@..MESS: .ASCIZ   /FILE NAME ALREADY TAKEN
052D        0D0A        @
052F        0D0A00      @/
                        @;
0532        21 053B     @ILLARG: LXI      H,..MESS;SEND MESSAGE TO CONSOLE

0535        CD 047A     @        CALL     MESSOUT
0538        C3 2028     @        JMP      DOS
053B        494C4C454741@..MESS: .ASCIZ   /ILLEGAL ARGUMENTS USED FOR DCOM

055A        0D0A        @
055C        0D0A00      @/
                        @;
055F        21 0568     @FULL:   LXI      H,..MESS;SEND MESSAGE TO CONSOLE

0562        CD 047A     @        CALL     MESSOUT
0565        C3 2028     @        JMP      DOS

0568        46494C452057@..MESS: .ASCIZ   /FILE WRITE ABORTED; DISK FULL
0585        0D0A        @
0587        0D0A00      @/

0590                             .LOC     590H
                                 .INSERT B:EVENTS
                        @;***********************************
                        @;*                                 *
                        @;*        SPECIAL EVENTS           *
                        @;*                                 *
                        @;***********************************
                        @;
                        @;
                        @;ENDEXP SR DISABLES INTERRUPTS, WRITES
                        @;DATA OUT TO DISK (BY CALLING DATWR),
                        @;UPDATES ENDFLG, AND JUMPS TO THE ADDR
                        @;PUT IN BY THE MAIN PROGRAM.
                        @;
0590        F3          @ENDEXP: DI               ;KILL INTERRUPTS
0591        CD 0487     @        CALL     DATWR   ;WRITE DATA
0594        21 059B     @        LXI      H,ENDFLG;UPDATE FLAG
0597        35          @        DCR      M       ;
0598        C3 0598     @NXTEXP: JMP      NXTEXP  ;JMP TO MAIN
059B                    @ENDFLG: .BLKB    1       ;END FLAG INITIALIZED
                        @                         ;BY MAIN PRGM
                        @;
                        @;
                        @;
                        @;* ** * ** * ** * ** * ** * ** * ** * ** *
                        @;
                        @;LITOFF:  THIS SR IS CALLED BY THE "PROCSR".
                        @;IT TURNS OFF THE LIGHT RELAY BY CLEARING
                        @;BIT 0 OF I/O PORT 24D AND RETURNS TO THE
                        @;PROCESSOR.
                        @;
059C        3E00        @LITOFF: MVI      A,0     ;
059E        D318        @        OUT      24D     ;
05A0        E1          @        POP      H       ;
05A1        C9          @        RET              ;
                        @;
                        @;
                        @;*  *  *  *  *  *  *  *  *  *  *  *  *  *  *
                        @;
                        @;LITON:  CALLED BY "PROCSR" TO TURN OFF LIGHTS
                        @;        BY CLEARING ALL BITS OF I/O PORT 24D
                        @;        AND THEN RETURNING TO THE PROCESSOR.
                        @;
05A2        3E01        @LITON:  MVI      A,1     ;
05A4        D318        @        OUT      24D     ;
05A6        E1          @        POP      H       ;
05A7        C9          @        RET              ;
                        @;

05B0                             .LOC     5B0H
                                 .INSERT B:L/DEXP.ASM
                        @;************************************
                        @;*                                  *
                        @;*     LIGHT/DARK EXPERIMENT        *
                        @;*                                  *
                        @;************************************
                        @;
                        @;THESE TWO ROUTINES SET UP THE INTRPT
                        @;HANDLER AND PROCESSOR TO DO FIRST A
                        @;DARK EXPERIMENT AND THEN A LIGHT EXPT.
                        @;THE SAMPLING AND PROCESSING PARAMETERS
                        @;ARE ASSUMED TO HAVE BEEN PUT IN THE PROPER
                        @;LOCATIONS BY SOME PREVIOUS ROUTINE (IE
                        @;BASIC CALLS, OR OTHER).  FLNAME AND
                        @;ENDFLG ARE ALSO ASSUMED TO HAVE BEEN
                        @;INITIALIZED BY PREVIOUS ROUTINES.
                        @;THE LIGHT/DARK EXPERIMENTS CONTINUE
                        @;UNTIL ENDFLG IS CLEAR.  THE LIGHT RELAY
                        @;IS TURNED ON BY SETTING BIT 0 OF I/O PORT
```

Listing 1 continued:

```
                        @;30Q.
                        @;
05B0                    @SDATA:  .BLKB    3       ;STORE DARK SAMPLING
                        @                         ;PARAMETERS HERE
05B3                    @PDATA:  .BLKB    34D     ;STORE DARK PROCESSING
                        @                         ;PARAMETERS HERE
05D5                    @SLDATA: .BLKB    3       ;STORE LIGHT SAMPLING
                        @                         ;PARAMETERS HERE
05D8                    @PLDATA: .BLKB    34D     ;STORE LIGHT PROCSR
                        @                         ;PARAMETERS HERE
                        @                         ;
05FA      3A 059B       @DRKEXP: LDA      ENDFLG  ;CHECK IF EXPT DONE
05FD      B7            @        ORA      A       ;
05FE      CA 065C       @        JZ       END     ;YES,END
0601      21 061F       @        LXI      H,LTEXP ;NO,PUT JMP ADDR IN
0604      22 0599       @        SHLD     NXTEXP+1;  "ENDEXP"
0607      21 018B       @        LXI      H,FLNAME+6 ;PUT "D" SUFFIX
060A      3644          @        MVI      M,"D"   ; IN FILENAME
060C      11 05B3       @        LXI      D,PDATA ;SET UP PROCSR
060F      CD 0468       @        CALL     P$INIT  ;
0612      11 05B0       @        LXI      D,SDATA ;SET UP INTHDLR
0615      CD 0430       @        CALL     INIT    ;
0618      E1            @RETSEQ: POP      H       ;RESTORE REGS
0619      E1            @        POP      H       ;
061A      C3 0352       @        JMP      RSTORE  ;
                        @;
                        @;
                        @;
061F                    @        .LOC     61FH
061F      3A 059B       @LTEXP:  LDA      ENDFLG  ;EXP DONE?
0622      B7            @        ORA      A
0623      CA 065C       @        JZ       END     ;YES, END
0626      21 05FA       @        LXI      H,DRKEXP ;NO,PUT JMP ADDR
0629      22 0599       @        SHLD     NXTEXP+1 ; IN "ENDEXP"
062C      21 018B       @        LXI      H,FLNAME+6 ;PUT "L" SUFFIX

062F      364C          @        MVI      M,"L"   ; IN FILENAME
0631      11 05D8       @        LXI      D,PLDATA;SET UP PROCSR
0634      CD 0468       @        CALL     P$INIT  ;
                        @;
                        @;       NOW RESET TRANSDUCERS AND ADVANCE THE
                        @;       ADVANCE THE LIGHT FILTER MOTOR.
                        @;       PORT 24 ASSIGNMENT:  BIT 0 = LIGHTS
                        @;                                1 = RESET DIFF
                        @;                                2 = MOTOR ADV.
                        @;                                7 = EXPT OFF
                        @;
0637      3E06          @STEPP:  MVI      A,6     ;SET BITS 1 & 2
0639      D318          @        OUT      24D     ;
063B      0E04          @        MVI      C,4     ;DO FOUR CYCLES OF
063D      CD 064C       @        CALL     WT50    ;50 MILLISEC WAIT
0640      3E00          @        MVI      A,0     ;CLEAR ALL BITS
0642      D318          @        OUT      24D     ;
0644      11 05D5       @        LXI      D,SLDATA;SET UP INTHDLR
0647      CD 0430       @        CALL     INIT
064A      18CC          @        JMPR     RETSEQ  ;RETURN TO STATUS
                        @;
                        @;  *   *   *   *   *   *   *   *   *   *   *   *   *   *
                        @;
                        @;THIS ROUTINE WAITS 0.049999875 SEC TIMES THE
                        @;CONTENTS OF THE C-REGISTER.
                        @;REGISTERS C,D, AND E ARE ALTERED.  ALL OTHERS
                        @;ARE PRESERVED.
                        @;
064C      11 378E       @WT50:   LXI      D,378EH ;SEE PAGE 223 OF BUGBOOK

064F      1D            @..LOOP: DCR      E       ;FOR EXPLANATION
0650      C2 064F       @        JNZ      ..LOOP  ;
0653      15            @        DCR      D       ;
0654      C2 064F       @        JNZ      ..LOOP  ;
0657      0D            @        DCR      C       ;
0658      C2 064C       @        JNZ      WT50    ;
065B      C9            @        RET              ;
                        @;
                        @;  *   *   *   *   *   *   *   *   *   *   *   *   *   *   *
                        @;
                        @;
                        @;
065C      21 0668       @END:    LXI      H,..MESS;SEND MESSAGE TO
065F      CD 047A       @        CALL MESSOUT     ;CONSOLE
0662      3E80          @        MVI      A,128D  ;SET BIT 7 OF
0664      D318          @        OUT      30Q     ;I/O PORT 30Q
0666      18B0          @        JMPR     RETSEQ  ;RETURN TO STATUS
0668                    @..MESS: .ASCIZ   /
0668      0D0A2A2A2A20@*** EXPERIMENT COMPLETED ***
0686      0D0A          @
0688      0D0A00        @/
                        @;
                        @;
                        @;*   *   *   *   *   *   *   *   *   *   *   *   *   *
                        @;
                        @;THIS IS A BASIC CALL SUBROUTINE WHICH STARTS
                        @;EXPERIMENT WITH A DARK PERIOD.
```

Listing 1 continued on page 422

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Listing 1 continued:

```
                     @;REGISTERS ARE NOT SAVED.
                     @;
068B     21 061F    @        LXI     H,LTEXP ;PUT JUMP ADDR INTO
068E     22 0599    @        SHLD    NXTEXP+1; "ENDEXP"
0691     21 018B    @        LXI     H,FLNAME+6; PUT "D" SUFFIX
0694     3644       @        MVI     M,"D"   ; INTO FILENAME
0696     11 05B3    @        LXI     D,PDATA ;SET UP PROCESSOR
0699     CD 0468    @        CALL    P$INIT  ;
069C     11 05B0    @        LXI     D,SDATA ;SET UP HANDLER
069F     CD 0430    @        CALL    INIT    ;START SAMPLING
06A2     C9         @        RET             ;RETURN
                     @;
                     @;       .INSERT B:HEADER.ASM
                     @;*********************************
                     @;*                               *
                     @;*           HEADER              *
                     @;*                               *
                     @;*********************************
                     @;
                     @;THIS SECTION RESERVES LOCATIONS AND
                     @;SETS UP THE HEADER MESSAGE.
                     @;
0700                @        .LOC    700H
                     @;
0700     202020202020@FLNM:   .ASCII  /
0708     0D0A        @/                      ;8 SPACES RESERVED FOR
                     @                       ;HEADER FILENAME
                     @;
070A     202020202020@DATE:   .ASCII  /
0715     0D0A        @/                      ;9 SPACES RESERVED FOR
                     @                       ;DATE
                     @;
0717     23204348414E@        .ASCII  /# CHANNELS:/
0722     202020      @HDCHNL: .ASCII  /   /   ;STORE #CHNLS HERE
                     @                       ; (ASCII)
                     @;
                     @        .ASCII  /
0725     0D0A234C4947@#LIGHT,DARK EXPTS:/
0739     202020      @CYCLES: .ASCII  /   /   ;STORE #CYCLES HERE
                     @;
                     @        .ASCII  /
073C     0D0A4441524B@DARK SAMPLING PARAMETERS:
0757     0D0A20202020@    SAMPLING RATE=/
076B     202020202020@DRATE:  .ASCII  /            /  ;STORE DARK
                     @                       ;SAMPLING RATE HERE
                     @;
                     @        .ASCII  $
0777     0D0A20202020@    #SAMPLES/DATA PT:$
078E     20202020    @DAVG:   .ASCII  /    /  ;STORE DARK S/DPT HERE
                     @;
                     @        .ASCII  /
0792     0D0A20202020@    TIME IN DARK:/
07A5     202020202020@DTIME:  .ASCII  /            /  ;STORE DARK TIME

                     @                               ;HERE
                     @;
                     @        .ASCII  /
07B1     0D0A4C494748@LIGHT SAMPLING PARAMETERS:
07CD     0D0A20202020@    LIGHT PERIOD:/
07E0     202020202020@LTPER:  .ASCII  /            /  ;STORE LIGHT
                     @                               ;PERIOD HERE
                     @;
                     @        .ASCII  /
07EC     0D0A20202020@    SAMPLING RATE:/
0800     202020202020@LRATE:  .ASCII  /            /  ;STORE LIGHT
                     @                               ;SAMPLING
                     @                               ;RATE HERE
                     @        .ASCII  $
080C     0D0A20202020@    #SAMPLES/DATA PT:$
0823     20202020    @LAVG:   .ASCII  /    /          ;STORE LIGHT
                     @                               ;S/DPT HERE
                     @;
                     @        .ASCII  /
0827     0D0A20202020@    PERIOD OF LIGHT SAMPLING:/
0846     202020202020@LTIME:  .ASCII  /            /  ;STORE TIME
                     @                               ;TO DO DARK
                     @                               ;PROCESSING
                     @                               ;HERE
                     @        .ASCII  /
0852     0D0A        @
0854     0D0A434F4D4D@COMMENTS:/
085F     2020202020  @COMNTS: .ASCII  /     / ;PUT COMMENTS HERE
                     @;
                     @;
                     @;
                     @;THIS ROUTINE FILLS THE REGISTERS WITH THE
                     @;PROPER ARGUMENTS FOR WRITING THE HEADER
                     @;TO DISK.  IT THEN CHANGES THE FILE NAME
                     @;PREFIX TO "DF" (FOR DATA FILE) AND RETURNS.
                     @;
08E0                @        .LOC    8E0H
08E0     3E01        @HDWRIT: MVI     A,1
```

Listing 1 continued:

```
08E2    11 0700     @        LXI     D,700H
08E5    01 0002     @        LXI     B,2
08E8    21 0185     @        LXI     H,FLNAME
08EB    CD 04C5     @        CALL    FWRITE
08EE    21 0185     @        LXI     H,FLNAME   ;CHANGE FILE NAME
                    @                           ;PREFIX
08F1    3644        @        MVI     M,"D"
08F3    23          @        INX     H
08F4    3646        @        MVI     M,"F"
08F6    C9          @        RET
                    @;
                    @;THIS ROUTINE OUTPUTS A MESSAGE LOCATED IN
                    @;RAM (DE) TO THE CONSOLE USING THE DOS
                    @;I/O ROUTINES AND THE D/A MESSOUT UTILITY.
                    @;
08F7    EB          @        XCHG            ;HL<=DE
08F8    CD 047A     @        CALL    MESSOUT
08FB    C9          @        RET
                    @;
                    @;
                    @;THESE TWO ROUTINES (CALLABLE BY BASIC)
                    @;DISABLE AND ENABLE INTERRUPTS .
                    @;
08FC    F3          @        DI      ;
08FD    C9          @        RET     ;
                    @;
08FE    FB          @        EI      ;
08FF    C9          @        RET
0900                         .LOC    900H
                             .INSERT B:OGRAFX.ASM
                    @;***********************************
                    @;****                           ****
                    @;****        OGRAFX             ****
                    @;****                           ****
                    @;***********************************
                    @;
                    @;THIS ROUTINE OUTPUTS DATA FROM THE PROCESSOR
                    @;BUFFER TO AN OSCILLOSCOPE VIA A/D PORT 26.  IT
                    @;EXPECTS THE CALLING PROGRAM TO HAVE PLACED IN
                    @;'DSPCHL' THE CHNL MINUS ONE TO BE DISPLAYED.
                    @;
                    @;ON ENTERING, DE SHOULD CONTAIN THE # OF PTS TO
                    @;DISPLAY.  A TRIGGER PULSE IS SENT OUT PORT 25
                    @;TO MARK THE BEGINNING OF THE DISPLAY.
                    @;
                    @;ONLY THE IX AND IY REGS ARE PRESERVED.
                    @;
                    @;
                    @;IN DSPLY LOOP THE REGS ARE USED AS FOLLOWS:
                    @;
                    @;               BC = # OF CHANNELS
                    @;               DE = # OF DATA PTS
                    @;               HL = ADDR OF DATA PTS
                    @;                A = DATA
                    @;
0900                @DSPCHL: .BLKB   1       ;PUT CHNL-1 TO SAMPLE
0901    00          @        .BYTE   0       ;KEEP 0 FOR PROPER ADD
                    @;
0902    14          @OGRAFX: INR     D       ;FOR PROPER COUNTING
0903    2A 017D     @        LHLD    BFSTRT  ;CALCULATE ADDR OF
                    @                        ;FIRST DATA PT
0906    ED4B 0900   @        LBCD    DSPCHL  ;
090A    B7          @        ORA     A       ;
090B    ED4A        @        DADC    B       ;
090D    3A 0137     @        LDA     CHNL    ;
0910    4F          @        MOV     C,A     ;PUT #CHNLS IN BC
0911    3E7F        @        MVI     A,127D  ;SEND TRIGGER PULSE
0913    D319        @        OUT     25D     ;
0915    3E00        @        MVI     A,0     ;
0917    D319        @        OUT     25D     ;
                    @;
0919    7E          @DSPLY:  MOV     A,M     ;DISPLAY DATA OUT 26
091A    D31A        @        OUT     26D     ;
091C    ED4A        @        DADC    B       ;INCR HL BY #CHNLS
091E    1D          @        DCR     E       ;DECREMENT POINTS CNTR
091F    20F8        @        JRNZ    DSPLY   ;
0921    15          @        DCR     D       ;
0922    20F5        @        JRNZ    DSPLY   ;
0924    20F3        @        JRNZ    DSPLY   ;LOOP TIL DONE
0926    C9          @        RET

                             .INSERT B:FREAD.ASM
                    @;******************************************
                    @;******                              ******
                    @;******         FREAD                ******
                    @;******                              ******
                    @;******************************************
                    @;
                    @;THIS SUBROUTINE READS A FILE FROM DISK TO
                    @;MEMORY USING THE NORTH STAR DOS ROUTINES.
                    @;
                    @;EXPECTS DE ON ENTERING TO BE A POINTER TO THE
                    @;RAM ADDR OF THE FILE NAME.  ALSO EXPECTS THE
```

Listing 1 continued on page 424

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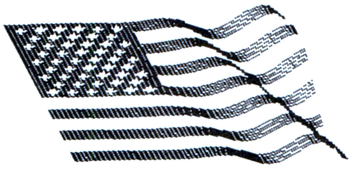

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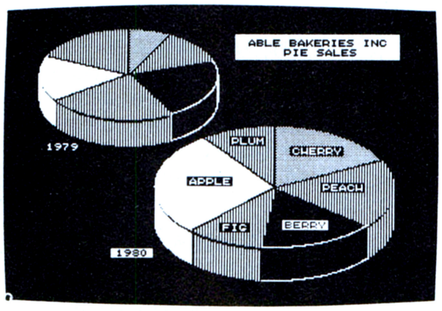

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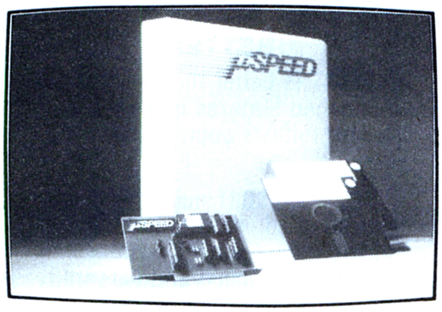

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Listing 1 continued:

```
                    @;FOLLOWING PARAMETER TABLE TO BE PROPERLY
                    @;FILLED IN:
                    @;
0927    01          @DSKDVR: .BYTE   1       ;USE DRIVE #1
0928                @FLADDR: .BLKW   1       ;STORE FILE PNTR HERE
                    @                        ;  (LOW/HIGH BYTES)
                    @;
                    @;
201C                @DLOOK = 201CH           ;JMP ADDR FOR DLOOK
2022                @DCOM  = 2022H           ;JMP ADDR FOR DCOM
2A04                @BASIC = 2A04H           ;ENTER BASIC
                    @;
                    @;FOR CONVENIENCE THE FILENAME MAY BE PLACED
                    @;IN THE FOLLOWING BLOCK:
092A                @        .BLKB   8       ;SAVE FOR FILENAME
0932    20          @        .BYTE   20H     ;ASCII BLANK
                    @;
                    @;ONLY IX,IY REGISTERS ARE PRESERVED.
                    @;
0933    EB          @FREAD:  XCHG            ;SET UP REGS FOR DLOOK
0934    3A 0927     @        LDA     DSKDVR  ;HL=PNTR TO FILENAME
                    @                        ;A =DISK UNIT #1
0937    CD 201C     @        CALL    DLOOK   ;
093A    3813        @        JRC     NOFILE  ;NO SUCH FILE, RETURN
                    @                        ;
093C    5E          @        MOV     E,M     ;SET UP REGS FOR DCOM
093D    23          @        INX     H       ;DE<=DISK ADDR
093E    56          @        MOV     D,M     ;
093F    23          @        INX     H       ;
0940    4F          @        MOV     C,A     ;C<=UNIT #1
0941    7E          @        MOV     A,M     ;A=# OF BLOCKS
0942    EB          @        XCHG            ;HL=DISK ADDR
0943    0601        @        MVI     B,1     ;B=READ COMMAND
0945    ED5B 0928   @        LDED    FLADDR  ;DE=FILE RAM ADDR
                    @;
0949    CD 2022     @        CALL    DCOM    ;
094C    381D        @        JRC     BOGUS   ;INVALID DCOM ARG
094E    C9          @        RET
                    @;
                    @;* * * * * * * * * * * * * * * * * * * * *
                    @;
094F    21 0958     @NOFILE: LXI     H,..MESS;SEND MSSGE TO CRT
0952    CD 047A     @        CALL    MESSOUT ;
0955    C3 2A04     @        JMP     BASIC   ;
                    @;
0958                @..MESS: .ASCIZ  /
0958    0D0A4E4F2053@NO SUCH FILE
0966    0D0A        @
0968    0D0A00      @/
                    @;
                    @;
096B    21 0974     @BOGUS:  LXI     H,..MESS;SEND MSSGE TO CRT
096E    CD 047A     @        CALL    MESSOUT ;
0971    C3 2A04     @        JMP     BASIC   ;
                    @;
0974                @..MESS: .ASCIZ  /
0974    0D0A494C4C45@ILLEGAL DCOM ARGUMENTS
098C    0D0A        @
098E    0D0A00      @/
                    @;
                      ;
                              .END

         ADRDAT 01B2         BASIC  2A04         BEEP   035D
         BFSTRT 017D         BLANK  050C         BOGUS  096B
         CHNL   0137         CLK2FS 0248         COMNTS 085F
         COUNT  0208         COUT   200D         CYCLES 0739
         DATE   070A         DATWR  0487         DAVG   078E
         DCOM   2022         DIVSR  013B         DLOOK  201C
         DOS    2028         DRATE  076B         DRKEXP 05FA
         DSKDVR 0927         DSPCHL 0900         DSPLY  0919
         DTIME  07A5         DWRIT  201F         END    065C
         ENDCK  0362         ENDEXP 0590         ENDFLG 059B
         ESTART 036B         ETIME  013D         FETCH  01AA
         FLADDR 0928         FLNAME 0185         FLNM   0700
         FNXN   041F         FREAD  0933         FULL   055F
         FWRITE 04C5         HDCHNL 0722         HDWRIT 08E0
         HYDCR  0366         ILLARG 0532         INIT   0430
         INTHLD 018E         INT$S  0138         LAVG   0823
         LITOFF 059C         LITON  05A2         LRATE  0800
         LTEXP  061F         LTIME  0846         LTPER  07E0
         MBUFPT 017F         MESSOU 047A         NEXT   02F9
         NOFILE 094F         NTMPAD 0183         NXTEXP 0598
         N$EVTS 013C         OGRAFX 0902         OTMPAD 0181
         OVFLAG 0247         OVFLOW 0372         PDATA  05B3
         PLDATA 05D8         PROCSR 02DD         P$INIT 0468
         RETSEQ 0618         RSTORE 0352         SAMPLE 019C
         SCNTR  013A         SDATA  05B0         SLDATA 05D5
         STDAT  01BB         STEPP  0637         STKPT  035B
         S$DPT  0139         TAKEN  050D         TMPBF1 01C8
         TMPBF2 01E8         TRANSF 02FF         UPDATE 0222
         WT50   064C
```

Listing 2: *BASIC program that demonstrates how parameters may be passed to the data-acquisition program in listing 1 (referred to as UTIL in the BASIC program comments).*

```
100!"  ---  THIS PROGRAM DEMONSTRATES HOW BASIC CAN"
110!"  ---  PLACE SAMPLING PARAMETERS IN  'UTIL'"
120!\!"       'UTIL' SHOULD ALREADY BE LOADED" \!
130 INPUT"NAME OF DATA FILE (8 CHARACTERS, I.E. 'DATA.01A'):",N$
140 REM
150 !\!"      FILENAME IS NOW PUT IN ADDRESS 185 HEX"
160 M=389         \REM  = 185 HEX = 'FLNAME'
170 FOR I=1 TO 8
180   FILL M,ASC(N$(I,I))
190   M=M+1
200 NEXT I
210 !\!"THE SAMPLING INITIATOR REQUIRES A TABLE CONTAINING"
220 !"THESE PARAMETERS:"
230 !
240 !"      # CHANNELS TO SAMPLE;"
250 !"      # INTERRUPTS PER SAMPLE;"
260 !"      # SAMPLES PER DATA POINT;"
262 !
264 !" 'UTIL' SAMPLES CONSECUTIVE CHANNELS, STARTING AT"
266 !" PORT 25 (DECIMAL) OF THE A/D BOARD.  TRY 4 TO BEGIN WITH."
270 !\INPUT"HOW MANY CHANNELS TO SAMPLE?",C
280 FILL 0,C   \REM     START THE TABLE AT 0000
290 !
300 !" # INTERRUPTS PER SAMPLE TELLS 'UTIL' HOW OFTEN THE"
310 !" A/D BOARD SHOULD BE CALLED.  FOR EXAMPLE, SUPPOSE"
320 !" THE REAL TIME CLOCK ON THE MOTHERBOARD WAS SET FOR"
330 !" A 53.248 MILLISEC INTERVAL.  IF YOU WANTED TO"
340 !" SAMPLE ONCE A SECOND, THEN # INTERRUPTS PER SAMPLE"
350 !" SHOULD BE 19 (53.248*19= 1.01 SEC)."
360 !\INPUT"          # INTERRUPTS PER SAMPLE?",I1
370 FILL 1,I1
380 !
390 !" # SAMPLES PER DATA POINT TELLS 'UTIL' HOW MANY SAMPLES"
400 !" TO AVERAGE.  THE NUMBER SHOULD BE A NUMBER N, SUCH THAT"
410 !" N EQUALS TWO RAISED TO AN INTEGER POWER (I.E., 1,2,4,8,...)"
415 !" SO THAT 'FNXN' WILL WORK PROPERLY. TRY 1 TO BEGIN WITH."
420 !
430 INPUT"      # SAMPLES PER DATA POINT (POWER OF 2)?",N
440 IF N>256 THEN 430
450 FILL 2,N
460 !
470 P=0            \REM  CALCULATE PROCESS CODE
480 IF N=1 THEN 520
490 N=N/2
500 P=P+1
510 IF N>1 THEN 490
520 IF N<1 THEN 430
530 FILL 3,P          \REM  START TABLE AT 0003
540 !" NOW A PARAMATER TABLE MUST BE SET UP FOR 'P$INIT'."
550 !" THE FIRST PARAMETER IS THE PROCESS CODE FOR 'FNXN'."
560 !" THIS IS CALCULATED AS THE POWER OF TWO WHICH EQUALS N."
570 !
580 !" THE SECOND PARAMETER IS THE # OF PROGRAMMED EVENTS."
590 !" IN THIS EXAMPLE WE WILL HAVE ONLY TWO EVENTS.  THE"
600 !" FIRST WILL SET BIT 0 OF PARALLEL PORT 24 (30 OCTAL)"
610 !" AND THE SECOND WILL TERMINATE SAMPLING, WRITE THE"
620 !" BUFFER TO DISK AND SEND A MESSAGE TO THE CONSOLE."
630 !" OF COURSE, THE FIRST EVENT SHOULD BE SET FOR A TIME"
640 !" PRECEEDING THE SECOND EVENT.  THE PROGRAMS FOR THESE"
650 !" EVENTS CAN BE FOUND IN MODULES 'SPECIAL EVENTS' AND"
660 !" 'LIGHT/DARK EXPERIMENT'."
670 FILL 4,2
680 !
690 !" THE TIME REQUESTED IS CALCULATED AS THE NUMBER OF"
700 !" DATA POINTS ( = # INTERRRUPTS PER SAMPLE * # OF SAMPLES"
710 !" PER DATA POINT).  THUS IF # INTRRPTS/SAMPLE EQUALS 19"
720 !" AND # SAMPLES/DATA PT EQUALS 8, THEN THERE WILL BE 8"
730 !" SECONDS PER DATA POINT (ASSUMING 53 MS CLOCK) AND THE"
740 !" TIME FOR EACH EVENT HAS UNITS OF 8 SECONDS."
750 !
760 INPUT"          TIME FOR EVENT #1: ",T1
770 REM  PUT THE TIME IN THE TABLE, HIGH BYTE FIRST.
780 FILL 5,INT(T1/256)
790 FILL 6, T1 - INT(T1/256)*256
800 REM  NOW PUT THE ADDR OF EVENT PROGRAM #1 IN THE TABLE
810 REM
820 FILL 7,162      \REM LOW BYTE OF ADDR 5A2 HEX
830 FILL 8,5       \REM HIGH BYTE
840 REM
850 INPUT"          TIME FOR EVENT #2: ",T2
860 FILL 9,INT(T2/256)
870 FILL 10, T2 - INT(T2/256)*256
880 !
```

Listing 2 continued on page 426

Circle 159 on inquiry card.

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A compact Bi-Level desk ideal for the Apple computer system. This 42″ × 29½″ desk comes with a shelf to hold two Apple disk drives. The top shelf for your TV or monitor and manuals can also have an optional paper slot to accomodate a printer. It is shown here with the optional Corvis shelf which will hold one Corvis disk drive. The Corvis shelf is available on the 52″ × 29½″ version of the Apple desk.

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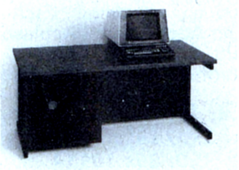

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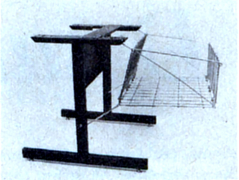

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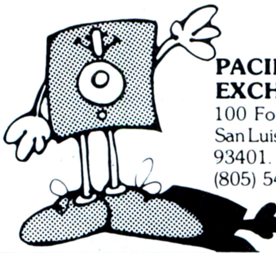

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Listing 2 continued:

```
890 REM  NOW PUT THE ADDR OF EVENT PROGRAM #2 IN THE TABLE
900 FILL 11,144     \REM LOW BYTE OF ADDR 590 HEX
910 FILL 12,5       \REM HIGH BYTE
920 REM
940 REM  'ENDEXP', THE ROUTINE THAT TERMINATES SAMPLING,
950 REM  REQUIRES THAT A JUMP ADDR BE FILLED IN. IT IS DONE
960 REM  BELOW
970 FILL 1433,92    \REM FILL 599 HEX WITH LOW BYTE OF ADDR 065C
980 FILL 1434,6     \REM FILL 59A HEX WITH HIGH BYTE OF ADDR
990 !
1000!" NOW THE PROCESSOR INITIALIZER IS CALLED."
1010 Q=CALL(1120,3)  \REM  3 = STARTING ADDR FOR PARAM. TABLE
1020 !
1030 INPUT"PRESS CARRIAGE RETURN TO START SAMPLING",Q$
1040 Q=CALL(1064,0)  \REM  0 = START OF PARAMETER TABLE
1050 !
1060 !"THIS BASIC PROGRAM IS ENDED, BUT SAMPLING WILL CONTINUE"
1065 !"UNTIL AN ENDING MESSAGE IS SENT TO THE CONSOLE."
1070 END
READY
```

Listing 3: *This program initializes the laboratory system for a sample biological experiment which will use all of the features of the lab system.*

```
1REM THIS PROGRAM INPUTS PARAMETERS FOR DOING A LIGHT/DARK
2REM EXPERIMENT.  IT PROMPTS THE USER FOR PARAMETERS, PLACES
3REM THEM IN THE L/DEXP PARAMETER STACKS AND WRITES A HEADER
4REM FILE DESCRIBING THESE PARAMETERS OUT TO DISK.
10 !TAB(20),"*** LIGHT/DARK EXPERIMENT ***"\!
20 !TAB(15),"A/D UTILITIES SHOULD ALREADY BE LOADED"\!
30 DIM C$(40)
40 K=53.248 \REM CLOCK INTRPT RATE IN MILLISEC
50 !\!"CLOCK INTERRUPT RATE= ",K," MSEC"
60 !"CHANGE LINE 40 IF DIFFERENT RATE"
100 REM FUNCTION CONVERTS A 4-DIGIT HEX NUMBER TO DECIMAL
105 DEF FNH(X$)
110 X=0
115 D=4096
120 FOR I=1 TO 4
125    T$=X$(I,I)
130    IF T$<="F" THEN 165
135    Y=VAL(T$)
140    Y=Y*D
145    D=D/16
150    X=X+Y
155    NEXT I
160 RETURN X
165 IF T$>="A" THEN 170 ELSE 135
170    Y=ASC(T$)
180    Y=Y-55
185    GOTO 140
190 FNEND
200 !"THESE ARE THE INPUTTED PARAMETERS:"\!\!
202 S1=FNH("03F7")
203 S2=FNH("0700")
205 C=CALL(S1,S2)
206 INPUT "PRESS CARRIAGE RETURN TO CONTINUE",K$
210 !\!"WHICH PARAMETERS DO YOU WANT TO ALTER?"
220 !TAB(8),"1=FILENAME/DATE"
225 !TAB(8),"2=# CHANNELS/# CYCLES"
230 !TAB(8),"3=DARK SAMPLING PARAMETERS"
235 !TAB(8),"4=LIGHT SAMPLING PARAMETERS"
240 !TAB(8),"5=COMMENTS"
245 !TAB(8),"6=ALL OF THE ABOVE"
247 !TAB(8),"7=NONE,BEGIN EXPERIMENT"
250 !\INPUT "WHICH NUMBER?",A
255 ON A GOTO 400,500,600,700,800,900,300
300 REM ***********************************
305 REM
310 REM WAIT FOR CARRIAGE RETURN, THEN WRITE OUT HEADER,
315 REM START SAMPLING AND CHAIN "STATUS,2" WHICH
320 REM HAS STATUS ROUTINES.
325 !\!"MAKE SURE DATA DISK IS ON DRIVE #1"
330 !TAB(8),"STATUS DISK IS ON DRIVE #2"
335 !\INPUT"PRESS CARRIAGE RETURN TO START SAMPLING",K$
340 Q=FNH("08E0")          \REM  WRITE HEADER
350 Q=CALL(Q)
360 Q=FNH("068B")          \REM  START SAMPLING
370 Q=CALL(Q)
390 CHAIN "STATUS,2"   \REM STATUS ON DRIVE #2
395 REM
397 REM *  *  *  *  *  *  *  *  *  *  *  *  *
398 REM
400REM INPUT FILENAME/DATE AND RETURN
410 GOSUB 1000
```

Listing 3 continued:

```
420 GOTO 200
500REM INPUT #CHANNELS/#CYCLES AND RETURN
510 GOSUB 1300
520 GOTO 200
600REM INPUT DARK SAMPLING PARAMETERS
610 GOSUB 1500
620 GOTO 200
700REM INPUT LIGHT SAMPLING PARAMETERS
710 GOSUB 2300
720 GOTO 200
800REM INPUT NEW COMMENTS
810 GOSUB 3400
820 GOTO 200
900REM INPUT ALL NEW PARAMETERS
910 GOSUB 1000
920 GOSUB 1300
930 GOSUB 1500
940 GOSUB 2300
950 GOSUB 3400
960 GOTO 200
1000 REM PUT FILENAME INTO PROPER RAM LOCATIONS
1010 REM 0700=HEADER ADDR, 0135=UTILITY ADDR
1020 INPUT "TYPE FILENAME (IE HD000..A): ",C$
1030 H=FNH("0700")
1040 L=LEN(C$)
1050 IF L>8 THEN 1020
1060 GOSUB 9999
1070 H=FNH("0185")
1080 GOSUB 9999
1090REM PLACE DATE INTO HEADER
1100 INPUT "TYPE DATE: ",C$
1110 H=FNH("070A")
1120 L=LEN(C$)
1130 IF L>11 THEN 1100
1140 GOSUB 9999
1150 RETURN
1300REM PUT #CHANNELS INTO HEADER AND PARAMETER STACKS
1310 INPUT "NUMBER OF CHANNELS TO SAMPLE: ",C
1320 IF C>7  THEN 1310
1330REM N=POINTER FOR DARK PARAM STACK
1340REM M=POINTER FOR LIGHT PARAM STACK
1350 N=FNH("05B0")
1360 FILL N,C
1370 N=N+1
1330 M=FNH("05D5")
1390 FILL M,C
1400 M=M+1
1410 H=FNH("0722")
1420 GOSUB 9997
1430REM INPUT #CYCLES INTO HEADER AND ENDFLAG
1440 INPUT "TYPE # OF DARK,LIGHT PERIODS: ",C
1450 IF C>99 THEN 1440
1460 B=FNH("059B")
1470 FILL B,C
1480 H=FNH("0739")
1490 GOSUB 9997
1494 RETURN
1500REM PUT SAMPLING RATE INTO HEADER AND INT/S INTO STACK
1540 !\!"DARK SAMPLING PARAMETERS:"
1550 !TAB(8),"DESIRED SAMPLING RATE (IN SEC): ",
1560 INPUT C
1570 C1=INT(C*1000/K +.5)
1580 C=C1*K/1000
1590 N=FNH("05B1")
1600 FILL N,C1
1610 N=N+1
1620 !TAB(3),"ACTUAL SAMPLING RATE= ",C," SEC"
1630 H=FNH("076B")
1640 GOSUB 9997
1650 C1=C
1660 C$=" S"
1670 GOSUB 9998
1680REM PUT S/DPT INTO STACK AND HEADER
1690 !TAB(3),"SAMPLES PER DATA POINT (POWER OF 2): ",
1700 INPUT C
1710 IF C>123 THEN 1690
1720 FILL N,C
1730 N=N+1
1740 H=FNH("073E")
1750 GOSUB 9997
1760 C2=C
1770REM PUT PROCESSOR CODE INTO STACK
1780 P=0
1790 IF C=1 THEN 1830
1800 C=C/2
1810 P=P+1
```

Listing 3 continued on page 428

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Listing 3 continued:

```
1820 IF C>1 THEN 1800
1830 FILL N,P
1840 N=N+1
1850 IF C<1 THEN 1690
1860REM PUT IN PROGRAMMED EVENTS
1870 FILL N,1
1880 N=N+1
1890 !TAB(8),"TIME IN DARK (X ,SEC/MIN/HR): ",
1900 INPUT C,K$
1910 C3=C1*C2
1920REM C1=SAMPLING RATE IN SEC, C2=#S/DPT
1930 IF K$="SEC"THEN 1980
1940 IF K$="MIN"THEN 1970
1950 IF K$="HR"THEN 1960 ELSE 1890
1960 C=C*60
1970 C=C*60
1980 C4=INT(C/C3+.5)
1990 C5=C3*C4
2000 IF K$="SEC" THEN 2030
2010 IF K$="MIN" THEN C5=C5/60
2020 IF K$="HR"THEN C5=C5/3600
2030 C6=0
2040 IF C4<256 THEN 2080
2050 C6=INT(C4/256)
2060 IF C6>255 THEN 1890
2070 C4=C4-C6*256
2080 FILL N,C6
2090 N=N+1
2100 FILL N,C4
2110 N=N+1
2120 !TAB(8),"ACTUAL TIME= ",C5," ",K$
2130 C=C5
2140 H=FNH("07A5")
2150 GOSUB 9997
2160 FILL N,FNH("0090")
2170 N=N+1
2180 FILL N,5
2190 N=N+1
2200 C$=" "+K$(1,1)
2210 GOSUB 9993
2220 RETURN
2300REM PUT LIGHT INT/S INTO STACK AND SAMPLING RATE IN HEADER
2310 !\!"LIGHT SAMPLING PARAMETERS:"
2320 !TAB(8),"DESIRED SAMPLING RATE (IN SEC): ",
2330 INPUT C
2340 C1=INT(C*1000/K +.5)
2350 C=C1*K/1000
2360 M=FNH("05D6")
2370 FILL M,C1
2380 M=M+1
2390 !TAB(8),"ACTUAL SAMPLING RATE= ",C," SEC"
2400 H=FNH("0800")
2410 GOSUB 9997
2420 C1=C
2430 C$=" S"
2440 GOSUB 9998
2450REM PUT S/DPT INTO STACK AND HEADER
2460 !TAB(8),"SAMPLES PER DATA POINT (POWER OF 2): ",
2470 INPUT C
2480 IF C>128 THEN 2460
2490 FILL M,C
2500 M=M+1
2510 H=FNH("0823")
2520 GOSUB 9997
2530 C2=C
2540REM PUT PROCESSOR CODE INTO STACK
2550 P=0
2560 IF C=1 THEN 2600
2570 C=C/2
2580 P=P+1
2590 IF C>1 THEN 2570
2600 FILL M,P
2610 M=M+1
2620 IF C<1 THEN 2460
2630REM PUT IN PROGRAMMED EVENTS
2640 FILL M,3        \REM 3 EVENTS
2650 M=M+1
2652 C3=C1*C2       \REM C3=SEC/DPT
2654REM C1=SAMPLING RATE IN SEC, C2=#S/DPT
2658 C4=INT(60/C3 + .5)   \REM CALCULATE 1-MIN
2660 FILL M,0
2662 M=M + 1
2664 FILL M,C4              \REM TURN ON LIGHT AFTER 1-MIN
2665 M=M+1
2666 FILL M,FNH("00A2")    \REM ADDR OF LITON
2667 M=M+1
2668 FILL M,5
2669 M=M+1
```

Listing 3 continued:

```
2680 !TAB(8),"LIGHT PERIOD (X ,SEC/MIN/HR): ",
2690 INPUT C,K$
2700 IF K$="SEC"THEN 2750
2710 IF K$="MIN"THEN 2740
2720 IF K$="HR"THEN 2730 ELSE 2660
2730 C=C*60
2740 C=C*60
2750 C4=INT(C/C3+.5) + C4
2760 C5=C3*C4
2770 IF K$="SEC" THEN 2800
2780 IF K$="MIN" THEN C5=C5/60
2790 IF K$="HR"THEN C5=C5/3600
2800 C6=0
2810 IF C4<256 THEN 2850
2820 C6=INT(C4/256)
2830 IF C6>255 THEN 2660
2840 C4=C4-C6*256
2850 FILL M,C6
2860 M=M+1
2870 FILL M,C4
2880 M=M+1
2890 FILL M,FNH("009C")
2900 M=M+1
2910 FILL M,5
2920 M=M+1
2930 C=C5-C3*INT(60/C3+.5)
2940 !TAB(8),"ACTUAL TIME= ",C," ",K$
2950 H=FNH("07E0")
2960 GOSUB 9997
2970 C$=" "+K$(1,1)
2980 GOSUB 9998
2990 !TAB(8),"PERIOD OF LIGHT SAMPLING (X,SEC/MIN/HR):",
3000 INPUT C,K$
3010 C3=C1*C2
3020REM C1=SAMPLING RATE IN SEC, C2=#S/DPT
3030 IF K$="SEC"THEN 3080
3040 IF K$="MIN"THEN 3070
3050 IF K$="HR"THEN 3060 ELSE 2990
3060 C=C*60
3070 C=C*60
3080 C4=INT(C/C3+.5)
3090 C5=C3*C4
3100 IF K$="SEC" THEN 3130
3110 IF K$="MIN" THEN C5=C5/60
3120 IF K$="HR"THEN C5=C5/3600
3130 C6=0
3140 IF C4<256 THEN 3180
3150 C6=INT(C4/256)
3160 IF C6>255 THEN 2990
3170 C4=C4-C6*256
3180 FILL M,C6
3190 M=M+1
3200 FILL M,C4
3210 M=M+1
3220 !TAB(8),"ACTUAL TIME= ",C5," ",K$
3230 C=C5
3240 H=FNH("0846")
3250 GOSUB 9997
3260 C$=" "+K$(1,1)
3270 GOSUB 9998
3280 FILL M,FNH("0090")
3290 M=M+1
3300 FILL M,5
3310 RETURN
3400REM INPUT COMMENTS
3410 !
3420 H=FNH("085F")
3430 INPUT "COMMENTS:",C$
3440 IF C$=""THEN 200
345 GOSUB 998
3460 C$=CH$(13)+CHR(10)
3470 GOSUB 9998
3480 IF H>=NH"ODF") THEN STOP
3490 GOTO 3430
3500 RETUR
9995REMSUBROUTINE TO PLACE STRING C$ OF LENGTH L
9996REM INTO MEMORY STARTING AT RAM H
                                        9997 C$=STR$(C)
9998 L=LEN($)
              9999 FOR I=1 TO L
10000    T$=C$(I,I)
10001    FILL ,ASC($
102    H=H+1
10003    NEXT I
10004 RETURN
READY
```

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Listing 4: *Program STATUS, which allows the operator to examine and control the progress of the sample experiment after running the program in listing 3. Both programs interact with the program in listing 1, which must be loaded into memory first.*

```
2 REM *********  STATUS  **********
4 REM
5 REM THIS PROGRAM FIRST WRITES OUT THE HEADER AND STARTS
6 REM THE EXPT, AND THEN PROMPTS FOR A CONTROL COMMAND
7 REM
21 REM
24 REM * * * * * * * * * * * * * * * * * * * * *
27 REM
30 REM THIS SR CONVERTS A HEX NUMBER TO DECIMAL
33 DEF FNH(H$)
36 L=LEN(H$)
39 D=1
42 X=0
45 FOR I=2 TO L
48   D=D*16
51   NEXT I
54 FOR I=1 TO L
57   T$=H$(I,I)
60   IF T$<="F" THEN 81
63   Y=VAL(T$)
66   Y=Y*D
69   D=D/16
72   X=X+Y
75   NEXT I
78 RETURN X
81 IF T$>="A" THEN 84 ELSE 63
84   Y=ASC(T$) - 55
87   GOTO 66
89 FNEND
90 REM
91 REM * * * * * * * * * * * * * * * * * * * * *
92 REM
100 REM
110 REM * * * * * * * * * * * * * * * * * *
120 REM
130 REM           THIS SECTION PROMPTS FOR A COMMAND
140 REM
142 !\!"CLOCK RATE = 53.248 MSEC; CHANGE LINE 7190 IF DIFFERENT"
144 !
150 !\!"EXPERIMENT IN PROGRESS - STATUS PROGRAM LOADED"
160 !\!"COMMANDS:"
170 !\!"    H = PRINT HEADER TO CONSOLE"
180 !  "    T = SHOW TIME INTO THIS CYCLE / # CYCLES LEFT"
190 !  "    A = ADVANCE TO NEXT CYCLE AFTER NEXT DATA PT"
200 !  "    E = END EXPT"
220 !  "    D = DISPLAY DATA IN BUFFER"
225 !  "    V = PRINT VOLTAGE LEVELS"
227 !  "    S = STOP INTERRUPTS"
229 !  "    R = RESTART INTERRUPTS"
230 !
240 INPUT"WHICH COMMAND?",C$
250 IF C$="H" THEN GOSUB  500
260 IF C$="T" THEN GOSUB 600
270 IF C$="A" THEN GOSUB 700
280 IF C$="E" THEN GOSUB 800
300 IF C$="D" THEN GOSUB 1000
305 IF C$="V" THEN GOSUB 4000
307 IF C$="S" THEN GOSUB 5000
309 IF C$="R" THEN GOSUB 6000
310 GOTO 150
480 REM
490 REM * * * * * * * * * * * * * * * * * * * * * * * *
495 REM
497 REM THIS SECTION CALLS AN ASSEMBLY ROUTINE
498 REM WHICH OUTPUTS THE HEADER VIA DOS I/O
499 REM
500 !
505 Q=CALL(2295,1792)
510 INPUT"PRESS CARRIAGE RETURN TO CONTINUE",Q$
550 RETURN
580 REM
585 REM * * * * * * * * * * * * * * * * * * * * * * * * * *
587 REM
590 REM         THIS SECTION LOOKS INTO RAM TO FIND TIME THIS
593 REM         CYCLE HAS BEEN RUNNING AND # OF CYCLES LEFT
595 REM
600 GOSUB 7000
602 T$=" SEC"
604 T4=T1*T2*K1*B6
606 IF T4>120 THEN T$=" MIN"
608 IF T4>120 THEN T4=T4/60
609 !
```

Listing 4 continued:

```
610 !"THIS CYCLE HAS BEEN RUNNING FOR ",%6F2,T4,T$
620 E1=FNH("059B")      \REM ADDR OF ENDFLAG
630 E1=EXAM(E1)
640 !"# OF CYCLES LEFT = ",E1
650 RETURN
680 REM
685 REM * * * * * * * * * * * * * * * * * * * * * * * *
688 REM
690 REM      THIS SECTION ENDS THE CURRENT CYCLE AND
695 REM      ADVANCES TO THE NEXT CYCLE AFTER THE
697 REM      NEXT DATA POINT
699 REM
700 E2=FNH("08FC")
710 Q=CALL(E2)      \REM DISABLE INTERRUPTS
720 M=FNH("013C")   \REM ZERO EVENT TIME CNTR
725 FILL M,1
730 M=M+1
735 FILL M,0
740 M=M+1
742 FILL M,1
745 M=M+1
750 FILL M,FNH("0090")
752 M=M+1
755 FILL M,5
760 OUT 24,0         \REM TURN OFF ALL RELAYS
770 Q=CALL(E2+2)     \REM ENABLE INTERRUPTS
780 RETURN
785 REM
788 REM * * * * * * * * * * * * * * * * * * * * * *
789 REM
790 REM        THIS SECTION ENDS THE EXPT BY PUTTING A ONE
792 REM        IN ENDFLAG AND THEN ENDING THE CURRENT CYCLE
795 REM
800 M=FNH("059B")
820 FILL M,1
840 GOSUB 700     \REM END CYCLE
860 RETURN
960 REM
970 REM * * * * * * * * * * * * * * * * * * * * * * *
980 REM * * * * * *   DISPLAY     * * * * * * * * * *
990 REM * * * * * * * * * * * * * * * * * * * * * * *
1000!\!"THIS PROGRAM GRAPHICALLY DISPLAYS DATA"
1010!"CONTAINED IN THE A/D UTILITIES BUFFER"
1020!
1030 GOSUB 7000     \REM FETCH CONSTANTS FROM RAM
1040 !
1050 ! "THERE ARE ",C1," CHANNELS WITH ",B6," POINTS EACH IN THE BUFFER"
1060 !\INPUT "WHICH CHANNEL DO YOU WANT DISPLAYED?",C2
1070 IF C2<1 THEN STOP
1080 IF C2 > C1 THEN 1060
1090 !\INPUT"DISPLAY TYPE? (C=CRT; O=OSCOPE; S=STRIP CHART):",D1$
1100 IF D1$="C" THEN 1500
1110 IF D1$="O" THEN 2000
1120 IF D1$="S" THEN 3000
1130 GOTO 1090
1140 REM
1470 REM
1475 REM * * * * * * * * * * * * * * * * * * * * * *
1480 REM
1485 REM THE FOLLOWING SECTION OUTPUTS THE DATA BUFFER
1490 REM GRAPHICALLY ONTO THE SOROC 120 CRT
1495 REM
1500 FOR I=1 TO 24
1505 ! \NEXT I          \REM CLEAR CRT
1510 REM
1515 REM
1520                     REM PUT TIME SCALE ON SCREEN
1525 OUT 2,27           \REM LOAD CURSOR
1530 OUT 2,61
1535 OUT 2,54
1540 OUT 2,32
1545 T3=A1*T1*T2*K1     \REM TIME PER DATA PT
1550 T$=" SEC"
1555 IF T3>=120 THEN T$=" MIN"
1560 IF T3>=120 THEN T3=T3/60
1565 !"EACH POINT = ",%5F1,T3,T$
1570 REM
1575 REM
1580 REM INITIALIZE X, AND DATA ADDR'S
1585 D1=B1 + C2 - 1          \REM ADDR OF DATA
1590 X=32                    \REM CURSOR X-POSITION
1615 Y=0                    \REM LOOP TILL DISPLAY DONE
1620 FOR I=1 TO A1
1625   Y=Y + EXAM(D1)       \REM AVERAGE PTS
1630   D1=D1+C1
1635   NEXT I
```

Listing 4 continued on page 432

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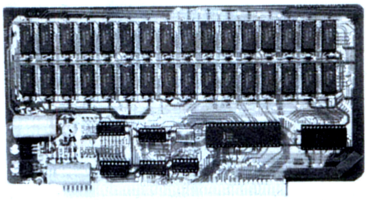

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Listing 4 continued:

```
1640 Y= INT(Y/A1 + .5)
1645 REM CONVERT TO 0-255 SCALE
1650 IF Y<128 THEN Y1=Y+128
1655 IF Y>127 THEN Y1= ABS(128-Y)
1660 Y=INT(Y1/10)
1665 IF Y>23 THEN Y=23     \REM SCALE TO 0-23 FOR CURSOR LOADING
1670 Y= ABS(23-Y) + 32     \REM Y-POSITION CODE
1675 OUT 2,27              \REM LOAD CURSOR AND OUTPUT CHAR
1680 OUT 2,61
1685 OUT 2,Y
1690 OUT 2,X
1695 OUT 2,C2+48
1700 X=X+1                 \REM UPDATE X
1705 IF X=112 THEN 1735
1710 IF X<B7+32 THEN 1615
1725 REM DISPLAY DONE, PROMPT FOR NEXT CHNL TO DISPLAY
1730 REM
1735 OUT 2,27              \REMLOAD CURSOR
1740 OUT 2,61
1745 OUT 2,55
1750 OUT 2,32
1755 INPUT1"CHANNEL TO DISPLAY (0=END)?",C2
1760 IF C2=0 THEN 150
1765 IF C2>C1 THEN 1755
1770 GOTO 1580
1775 REM
1990 REM
1995 REM * * * * * * * * * * * * * * * * * * * * *
1996 REM
1997 REM THE FOLLOWING SECTION OUTPUTS THE DATA BUFFER
1998 REM TO THE OSCOPE VIA D/A PORT 26 WITH THE TRIGGER
1999 REM PULSE COMING OUT PORT 25
2000REM
2100 P1=FNH("0900")    \REM  ADDR TO PUT CHNL CODE
2120 C3=C2-1           \REM  CHNL CODE
2140 FILL P1,C3
2145 T$=" SEC"         \REM CALCULATE TIME SCALE
2150 T4=K1*B6*T1*T2
2155 IF T4>=120 THEN T$=" MIN"
2160 IF T4>=120 THEN T4=T4/60
2170 !\!"CHANGE ANY BIT OF PORT 24 FOR NEW CHANNEL"
2175 !\!"TOTAL OUTPUT = ",%6F1,T4,T$
2177 P9=INP(24)
2180 Q=CALL(P1+2,B6)     \REM OUTPUT BUFFER
2190 IF INP(24)=P9 THEN 2180 ELSE 2200
2200 INPUT"WHICH CHANNEL DO YOU WANT TO DISPLAY?(0=END):",C2
2220 IF C2<1 THEN 150
2230 GOSUB 7000
2240 IF C2>C1 THEN 2200
2260 GOTO 2100
2990 REM
2995 REM * * * * * * * * * * * * * * * * * * * * * *
2997 REM
2998 REM THIS ROUTINE OUTPUTS THE DATA BUFFER
2999 REM VIA PORT 26 TO THE STRIP CHART RECORDER
3000 T$=" SEC"        \REM CALCULATE TIME SCALE
3010 T4=K1*B6*T1*T2
3020 IF T4>=120 THEN T$=" MIN"
3030 IF T4>=120 THEN T4=T4/60
3040 !"TOTAL OUTPUT = ",%6F1,T4,T$
3050 !\INPUT "PRESS CARRIAGE RETURN TO START OUTPUT",Q$
3060 !\!"CHANNEL ",C2," BEING OUTPUT",
3070 REM
3080 D1=B1 + C2 - 1     \REM INITIALIZE DATA PT ADDR
3090 REM
3100 FOR I=1 TO 10      \REM OUTPUT STARTING POINTS
3110    OUT 26,128
3120    GOSUB 8000      \REM DELAY SR
3130    NEXT I
3140 REM
3150 REM          OUTPUT BUFFER TILL DONE
3160 FOR I=1 TO B6
3170    Y=EXAM(D1)
3180    OUT 26,Y
3190    D1=D1 + C1
3200    GOSUB 8000
3210    NEXT I
3220 REM
3230 REM            OUTPUT ENDING POINTS
3240 FOR I=1 TO 10
3250    OUT 26,128
3260    GOSUB 8000
3270    NEXT I
3280 REM
3290 REM           \!\!\!"DISPLAY FINISHED"
3300 !
```

Listing 4 continued:

```
3310 INPUT"WHICH CHANNEL DO YOU WANT TO DISPLAY?(0=END)",C2
3320 IF C2<1 THEN 150
3330 IF C2>C1 THEN 3310
3340 GOTO 3040
4000 REM
4020 REM     ***  THIS SECTION PRINTS THE VOLTAGE
4040 REM     ***  OUTPUTS FOR EACH DIFF. CHANNEL
4060 REM
4080 DO= -2.00            \REM DIFF OFFSET
4100 !"DIFFERENTIATOR OFFSET = ",DO," VOLTS"
4120 C1=FNH("0137")
4140 C1=EXAM(C1)          \REM # CHNLS
4160 FOR I=1 TO C1
4180     VO=INP(24+I)
4200     IF VO<128 THEN V1=VO+128  \REM SCALE 0-255
4220     IF VO>127 THEN V1=ABS(128-VO)
4240     V1=(V1*.02) -2.56
4260     !"CHANNEL ",I," = ",V1," VOLTS"
4280 NEXT I
4300 RETURN
5000REM          ***
5010REM          ***      SR TO DISABLE INTERRUPTS
5020REM          ***
5030 Q=FNH("08FC")
5040 Q=CALL(Q)
5050 RETURN
6000REM          ***
6010REM          ***      SR TO RESTART INTERRUPTS
6020REM          ***
6030 Q=FNH("08FE")
6040 Q=CALL(Q)
6050 RETURN
7000 REM * * * * * * * * * * * * * * * * * * * * *
7010 REM
7020 REM THIS SECTION FETCHES CONSTANTS FROM RAM
7030 REM
7040 B1=FNH("1000")     \REM  BUFSTRT
7050 B2=FNH("017F")     \REM  CONVERT MBUFPT TO DECIMAL
7060 B3=B2+1
7070 B2=EXAM(B2)
7080 B3=EXAM(B3)*256
7090 B4=B3 + B2
7100 B5=B4 - B1         \REM #PTS IN BUF
7110 REM
7120 C1=FNH("0137")
7130 C1=EXAM(C1)        \REM # CHNLS
7140 REM
7150 B6=B5/C1           \REM #PTS/CHNL
7160 A1=INT(B6/80 + .3)  \REM # PTS TO AVE FOR DISPLAY
7170 IF A1=0 THEN A1=1
7180 B7=INT(B6/A1)
7190 K1=.053248        \REM CLOCK INTERRUPT RATE
7200 T1=FNH("0138")
7210 T2=T1 + 1
7220 T1=EXAM(T1)        \REM #INT/SAMPLE
7230 T2=EXAM(T2)        \REM # SAMPLES/DATA PT
7240 RETURN
7900 REM
7910 REM   * * * *   DELAY BETWEEN DATA OUTPUT   * * * *
7920 REM
8000 FOR J=1 TO 20 \NEXT J
8100 RETURN
9000 END
READY
```

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eighteen
nineteen
twenty
thirty
forty
fifty
sixty
seventy
eighty
ninety
hundred
thousand
million
zero
again
ampere
and
at
cancel
case
cent
400hertz tone
80hertz tone
20ms silence
40ms silence
80ms silence
160ms silence
320ms silence
centi
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comma
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Software Review

Five Spelling-Correction Programs for CP/M-Based Systems

Phil Lemmons
89 Remsen St
Brooklyn NY 11201

When I had trouble with an applications program last year, I appealed to my software vendor for help. He wrote me, "I have been in touch with the publisher, but I am getting noware fast." Noware, of course, was the leading technology before the invention of hardware, software, and firmware. Was noware making a comeback? No way. "Noware" was a spelling error. And the only way for a poor speller to discover errors like this was with software. But no proofreading software was then available for microcomputers.

At a Glance

Name
The Word

Author
Wayne Holder

Type
Proofreader for spelling errors, including 45,000-word literal dictionary, as well as programs to look up words in a dictionary on disk, count words, report on word frequency, search dictionary for words matching letter patterns, and sort words in a file into an alphabetical list with all redundancy eliminated

Manufacturer
Oasis Systems
2765 Reynard Way
San Diego CA 92103
(714) 291-9489

Price
$75

System Requirements
CP/M 1.4 or 2.2 operating system, CDOS, or IMDOS; 8080/85 or Z80 CPU with 32 K bytes of memory; one or two disk drives; keyboard input and hard-copy output; CP/M-compatible word processor, including WordStar, WordMaster, Ed, and Magic Wand

Format
CP/M single-density 8-inch disk

Language
8080 machine language

Documentation
30 pages, soft cover, stapled

Audience
Anyone with a CP/M-compatible word-processing system, especially writers and editors

Until recently, I didn't think the time had come for a good proofreading program running on microcomputers. Fortunately, I was wrong. Help has now arrived for the small-computer owner who can't spell or can't find misspellings. Not counting programs designed for use with only a single word-processing program, at least five proofreading programs are now available for CP/M-based computers: Microproof, The Word, Spellguard, Microspell, and Wordsearch. After using them for several weeks, I'm convinced that four have real merit. The four useful programs share some virtues, but each program also has features that appeal to a particular group of users.

You might base your choice among the four programs on the characteristics of your hardware—particularly the disk capacity. Or your word-processing software might mesh well with one of the programs, depending, for example, on whether your text editor will let you run a proofreading program from inside (ie: as a pseudocommand in the editor). Then again, each program has its own way of letting the user deal with a text file. Would you prefer a program that quickly checks a file and prints a list of suspect words? Or would you rather have the program present the suspect words to you one by one, so you can see if the word is really misspelled? Or how about a program that lets you see each word's context and change the original text? Another important criterion is price, and the range is great.

I'll discuss each of the five programs in turn, including their performance in benchmark tests. But first I'll state the opinions I've formed about what a proofreading program must do to be useful. Also, I'll explain how I tried to devise benchmarks that are meaningful for five programs, all of which work differently.

What a Proofreading Program Must Do

If you told someone it was okay to bring a few friends to your party, how would you feel if 500 strangers appeared? You'd feel the same way about a proofreading program that found fifty suspect words for every one that was actually misspelled. A proofreading program that finds all the misspelled words in a document is of little use if the program also finds hundreds of correctly spelled words suspect. How can the list of suspect words be kept manageable? It requires an extensive dictionary; I think 20,000 words is the minimum. The words must be correct and well chosen.

Another feature that keeps down the number of correct words mistaken for misspellings is the ability to create special dictionaries for your particular interests. Proofreading programs can also recognize more words by breaking words into roots, prefixes, and suffixes before checking the dictionary. But that has its drawbacks, because you can't stick any suffix or prefix on any root and get a real word.

A proofreading program should also provide a handy way to dispose of suspect words that are in fact correct. If a program presents the suspect words in one list, you need a quick way to delete correct words from the list. If a program presents suspects one at a time, you should be able to accept or reject each word with a single keystroke.

Equally important, the program must facilitate correction of misspelled words. One way is to mark suspect words in the original text file with a character that's easy to find later by using a text editor's search command. In

At a Glance

Name
Spellguard

Author
Denis Coleman

Type
Proofreader for spelling errors, including 20,000-word literal dictionary

Manufacturer
Innovative Software Applications
POB 2797
Menlo Park CA 94025
(415) 326-0805

Price
$295

System Requirements
CP/M 1.4, 2.0, or later operating system, or CDOS; 8080/85 or Z80 CPU with 32 K bytes of memory; one or two disk drives; keyboard input and hard-copy output; CP/M-compatible word processor, such as WordStar, WordMaster, Magic Wand, Electric Pencil, or Ed

Format
CP/M single-density 8-inch disk; North Star double-density 5-inch disk; or SuperBrain 5-inch CP/M disk

Language
8080 machine language

Documentation
116 pages in three-ring binder

Audience
Anyone with a CP/M-compatible word-processing system

At a Glance

Name
Wordsearch

Type
Proofreader for spelling errors, including 7200-word literal dictionary, with routines to list misspelled words and display the text file with misspellings highlighted

Manufacturer
Keybits Incorporated
POB 592293
Miami FL 33159
(415) 524-8098

Price
$195

System Requirements
CP/M-compatible operating system; 8080 or Z80 CPU with 32 K bytes of memory; dual 8-inch single-density disk drives; 24 by 80 video terminal; CP/M-compatible word processor

Format
CP/M single-density 8-inch disk

Language
8080 machine language

Documentation
46 pages in three-ring binder

Audience
Anyone with a CP/M word-processing system

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that case, the mark should be easy to delete during editing. And the mark should be made in a disk file, not on paper. Working from paper is too slow.

Another way for a proofreading program to facilitate correcting misspelled words is to provide a means to replace the word in the original file. With some word processors, however, this approach runs the risk of disturbing the format of the original text—especially in justified copy.

No matter what its other virtues, a proofreading program must also work quickly. Most significant among the factors affecting the speed of operation is the size of the dictionary. Putting too many little-used words in the dictionary may sacrifice speed in proofreading without reducing the number of suspect words. Putting too few words in the dictionary results in long lists of suspect words, and that also wastes time. The dictionary must strike a balance.

Benchmarks

Originally, I thought I could just run each program until it finished and note how long it took. But no two programs finished in the same place. Spellguard proofreads the file, lets you judge each suspect word, and then Spellguard itself marks the words indicated. The Word proofreads the file, gives you a list of suspect words, and lets you trim the list with your own text editor; you can mark the confirmed misspellings by running The Word's

At a Glance

Name
Microspell

Author
Bob Lucas

Type
Proofreader for spelling errors, including 26,000-word literal dictionary and suffix-stem logic to encompass a wider vocabulary, with integral routines to display the context of a misspelled word, guess the word intended, look up words in the dictionary, count words, search dictionary for words matching letter patterns, and correct the misspelling in the original text file

Manufacturer
Lifeboat Associates
1651 Third Ave
New York NY 10028
(212) 860-0300

Price
$249

System Requirements
CP/M 1.4 or 2.2 operating system; 8080 or Z80 CPU with 48 K bytes of memory; one disk drive with at least 150 K bytes; keyboard input and hard-copy output; CP/M-compatible word processor

Format
Great variety of CP/M disk formats

Language
8080 machine language

Documentation
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Audience
Anyone with a CP/M-compatible word-processing system

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At a Glance

Name
Microproof

Author
Phillip Manfield

Type
Proofreader for spelling errors, including 50,000-word dictionary (counting words constructed from roots, prefixes, and suffixes), with optional routines to display the context of a misspelled word and correct the misspelling in the original text file

Manufacturer
Cornucopia Software
POB 5028
Walnut Creek CA 94596
(415) 524-8098

Price
$169 standard version;
$60 for correcting option

System Requirements
CP/M 1.4 or 2.2 operating system or TRSDOS for Model I, II, or III TRS-80; Z80 CPU with 32 K bytes of memory; one 5-inch or 8-inch disk drive; keyboard input and hard-copy output; word processor

Format
CP/M 8-inch single-density; TRS-80 Model I, II, or III

Language
Z80 machine language

Documentation
24 pages, no cover, stapled

Audience
Anyone with a CP/M or TRS-80 word-processing system

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MARK program from inside your text editor. Microspell and Microproof let you review each word, but there's no need to mark bad words because these two programs make corrections directly in the text file. Since Wordsearch neither marks suspect words in the text file nor corrects errors itself, you have to work from paper.

For a quick comparison and summary of the differences between the programs, see tables 1 and 2.

How Long Until When?

It was easy to compare how long the programs take to check the words in a document against the dictionary and then list all the suspect words. But that comparison didn't really measure how the programs perform in normal use. Since Spellguard and The Word both mark words in the text file, I wanted to compare how long they take to proofread a file and mark the suspects. But you have to

	Words	Bytes	Files	Common Proper Names	Common Place Names	User Add Words	User Make Special Dictionaries
Microproof	50,000*	72 K	3	No	No	Yes	Yes
Microspell	26,000**	154 K	4	Yes	Yes	Yes	Yes
Spellguard	20,000	170 K	1	No	No	Yes	Yes
The Word	45,000	160 K	1	Yes	Yes	Yes	Yes
Wordsearch	7200	72 K	2	No	No	Yes	Yes

* This is not a literal dictionary. The figure 50,000 includes all the words that can be formed by adding suffixes and prefixes to roots; therefore, some "words" included in the count are not true English words.

** Incorporating all the ED.VOC vocabulary file and three-fourths of the ING.VOC vocabulary file into the four-file main dictionary. Both VOC files are supplied with the program and can be added to the main dictionary if disk space permits. Though Microspell claims only a 26,000-word dictionary, its suffix-and-root functions help the program recognize about the same number of words as a 45,000-word literal dictionary.

Table 1: *Comparison of the dictionaries of the five proofreading programs. Dictionaries for Spellguard, The Word, and Wordsearch are literal. Microspell has a 20,000-word literal dictionary, but provides more words in the files ING.VOC and ED.VOC, most of which were added to the original dictionary. Microspell's dictionary uses suffix-root routines to extend its coverage to a range somewhat broader than Microproof's dictionary. Although the Microproof dictionary claims contents of 50,000 words, that includes many nonwords formed by adding prefixes and suffixes to roots.*

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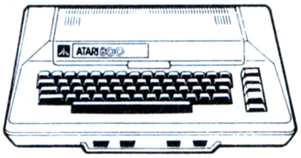

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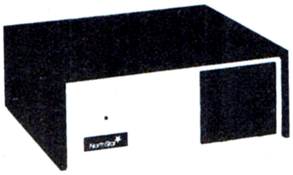

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run your text editor before The Word marks the file, and it seemed unfair to charge The Word for the time needed to load the text editor. After all, with The Word, the text editor is already loaded when you finish marking the file, so you can make corrections almost immediately. With Spellguard, you still have to load the text editor to make corrections; it's just that you load the editor *after* marking the errors.

To complicate matters, fairness to Microspell and Microproof—the direct-correction programs—requires seeing how long it takes to run the other proofreading programs *plus* exiting those programs and loading your own text editor to make corrections *plus* saving the corrected file. On the other hand, is it fair to hold those other programs responsible for the time it takes me to run an elaborate word processor like WordStar? Would it be fairer to use a smaller editor?

Right or wrong, here's what I decided to do: I've given the time each program needs to scan a text file and list all the suspect words; I've given the time the marking programs need to scan the text file, review the suspects, mark the text file, plus the time needed to load the text editor and call up the text file for editing (that seems fair to Spellguard and The Word); I've given the time each program needs to do all the above, plus making corrections and saving the corrected file (to be fair to Microproof and Microspell).

What Is a Suspect Word?

I decided to count as a suspect word both every word

	Mark Word	Correct Word	Guess Word	Find Similar Words	Display Context	Count Word Frequency
Microproof	No	Yes*	No	No	Yes*	No
Microspell	No	Yes	Yes	Yes	Yes	No
Spellguard	Yes	No	No	No	No	No
The Word	Yes	No	Yes	Yes	No	Yes
Wordsearch	No	No	No	No	Yes	No

* Requires the correcting option.

Table 2: *A summary of the features of the five proofreading programs. Sometimes the same feature is implemented differently in different programs.*

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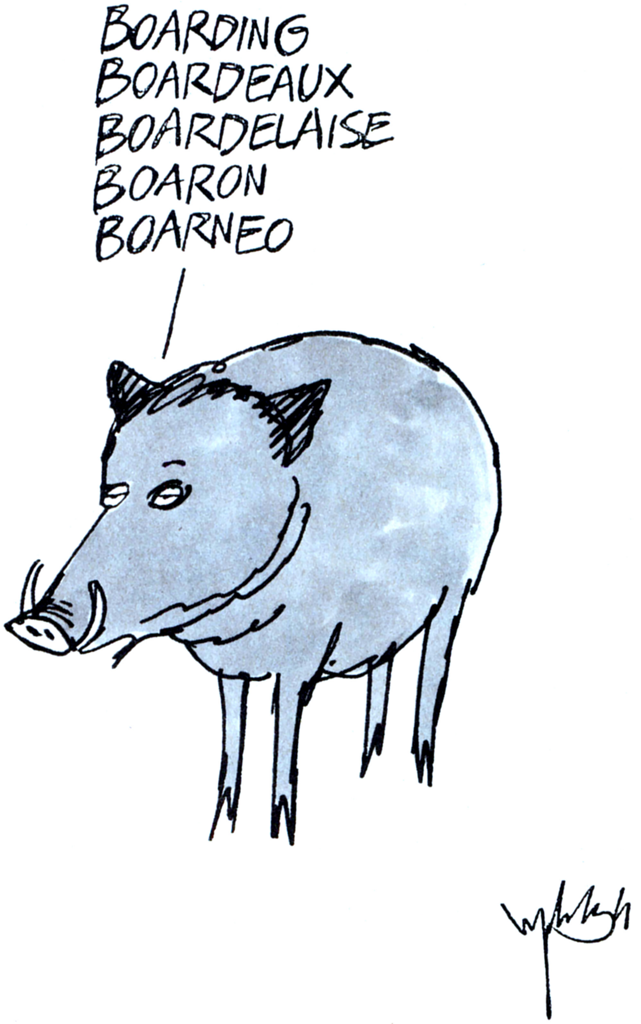
HISSTOLOGY
HISSPANIC
HISSTAMINE



and word *fragment* listed by the proofreading program. For programs that treat hyphens as spaces, I counted the fragments "accom" and "plished" as two suspect words. My rationale is that the fragments usually appear alphabetically and I have to consider each fragment and determine whether it is a misspelled word or not. Word fragments take the same amount of work as words.

This concludes the discourse on method. I tested the programs on a 400-word file (figure 1) and a 3000-word file. The results are shown in tables 3 and 4.

Spellguard Version 1.0

Spellguard is a magnificent program of the highest commercial quality. If your main concerns are speed and accuracy in straightforward proofreading, and if you have plenty of disk space, Spellguard is probably for you. Spellguard is menu-driven and the screen tells you all you need to know. The program lets you make every decision with a single keystroke.

The Package—In addition to its dictionary (170 K bytes), Spellguard includes the programs SP.COM (6 K bytes), SP.ISA (38 K bytes), and MAINTAIN (14 K bytes). SP.COM, SP.ISA, and the dictionary must all be present for Spellguard to operate (though the dictionary can be on a different disk drive). MAINTAIN is needed only when you wish to verify that Spellguard is working properly. ISA (Innovative Software Applications) also offers a limited dictionary for systems with low-capacity disks, and will soon offer dictionaries both more compact and more comprehensive, as described below.

Dictionary—As of this writing, Spellguard's dictionary contains approximately 20,000 words and takes up 170 K bytes of disk space. Spellguard's dictionary is literal; the program never assembles words from roots and suffixes. Denis Coleman, Spellguard's author, started work on it after writing a book in which he misspelled his own name. Coleman also saw the need for proofreading papers he wrote as a management consultant.

Coleman based the dictionary on two sources: Kucera's word-frequency study of 1962 and the *American Heritage Word Frequency Book* (Boston: Houghton Mifflin Company, 1971). It also includes words drawn from Coleman's own documents and papers of Spellguard users.

ISA will soon offer a version of its standard 20,000-word dictionary compressed to 32 percent of its present size, about 55 K bytes. In addition, it plans three additional dictionaries: a 30,000- to 40,000-word general dictionary, a 15,000-word medical dictionary, and a 15,000-word legal dictionary. Data compression will be standard in all of them. According to Coleman, ISA's techniques of data compression will result in increased operating speed for Spellguard.

Performance—Though Spellguard needed only 56 seconds to proofread the file shown in figure 1 and

	Misspelled Words in File	Words Found Suspect	Words Wrongly Found Suspect	True Mis-spellings Found	Misspelled Words Missed	Time to Proofread File	Time Until Ready to Correct	Time Until All Corrections
Microproof	7	32	26	6	1	0:45		2:16**
Microspell	7	26	20	6	1	1:06*		2:47**
Spellguard	7	47	40	7	0	0:56•	2:31••	3:40
The Word	7	19	12	7	0	1:39'	3:15''	4:00
Wordsearch	7	105	98	7	0	0:55°	4:56°°	6:13°°°

* Using the switches that suppress display of context and creation of an output file of suspect words.

** Microproof and Microspell do not require a text editor to make corrections. However, since both programs accepted an incorrect word in this file, correcting that word required running the text editor and saving the file. When Microspell or Microproof misses a word, about 1:20 must be added to the timing shown.

• Skipping the regular word review, going to the special word review, and asking that all suspect words be listed at once (Option L on Special Word Review Menu).

•• Time to proofread, review suspect words one by one, mark legitimate errors, load WordStar, and call up text file to start making corrections.

' Time to proofread and list suspect words found.

'' Time to proofread, load WordStar, use WordStar to edit list of suspect words, save shortened file of suspect words, run The Word's MARK program while still inside WordStar, and call up marked text file to make corrections.

° Running the Scan function followed by the List function.

°° Time to proofread file, assign words to one of three groups, print a list of confirmed misspellings, load WordStar, and call up unmarked text file. Wordsearch neither marks errors nor corrects.

°°° Since Wordsearch doesn't mark errors, each misspelled word had to be typed in as a search string, and that added to the time required to make corrections.

Table 3: *Performance of the proofreading programs on the 400-word text file in figure 1. The first timing shows how long each program takes to read the file and list all suspect words. The second timing shows how long each program takes to read the file, find the suspect words, decide which suspects should be marked, mark the suspects, and call up the text file to make corrections. Microproof and Microspell have no timing in this column because they make corrections in the original text file. The third timing shows how long it takes to read the file, find the suspect words, decide which suspects should be marked or corrected, make the corrections (in some cases directly, in other cases using a word processor), and save the file. In cases where Microspell or Microproof failed to recognize a misspelled word, the user must load a word processor and make the correction. That process adds about 1:20 to the third timing for Microproof or Microspell.*

	Misspelled Words in File	Words Found Suspect	Words Wrongly Found Suspect	True Mis-spellings Found	Misspelled Words Missed	Time to Proofread File	Time Until Ready to Correct	Time Until All Corrections
Microproof	10	109	99	10	0	1:09		4:28
Microspell	10	55	45	9	1	2:15*		7:15**
Spellguard	10	151	141	10	0	1:06•	4:40••	6:35
The Word	10	52	42	10	0	2:05'	4:52''	6:42
Wordsearch	10	517	507	10	0	1:06°	10:21°°	13:31°°°

* Using the switches that suppress display of context and creation of an output file of suspect words.

** Microspell does not require a text editor to make corrections. However, since Microspell accepted an incorrect word in this file, correcting that word required running the text editor and saving the file. When Microspell misses a word, about 1:20 must be added to the timing shown.

• Skipping the regular word review, going to the special word review, and asking that all suspect words be listed at once (Option L on Special Word Review Menu).

•• Time to proofread, review suspect words one by one, mark legitimate errors, load WordStar, and call up text file to start making corrections.

' Time to proofread and list suspect words found.

'' Time to proofread, load WordStar, use WordStar to edit list of suspect words, save shortened file of suspect words, run The Word's MARK program while still inside WordStar, and call up marked text file to make corrections.

° Running the Scan function followed by the List function.

°° Time to proofread file, assign words to one of three groups, print a list of confirmed misspellings, load WordStar, and call up unmarked text file. Wordsearch neither marks errors nor corrects.

°°° Since Wordsearch doesn't mark errors, each misspelled word had to be typed in as a search string, and that added to the time required to make corrections.

Table 4: *Performance of the proofreading programs on a 3000-word text file. The same comments apply as in the caption for table 3.*

display a list of suspect words, that isn't the standard procedure. To achieve that timing, I skipped the regular word review and took the List option on the Special Word Review Menu—calling for a display of all the suspect words at once. In normal use, running Spellguard takes longer because suspect words are presented individually to be marked in the text file, ignored, or added to the dictionary. But Spellguard lets you dispose of each word so easily that you can quickly consider each suspect word and pare a long list down to manageable size. When I proofread the same 400-word file using Spellguard's regular step-by-step word review, I needed only 50 seconds more to deal with forty-seven suspects, and that includes the time Spellguard needed to mark errors in the text file. Once the larger Spellguard dictionaries appear, the list of suspects should be shorter and even easier to deal with.

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Before making corrections, I had to change disks and run WordStar, my text editor, and call up the text file. Those steps took an average of 45 seconds. So a minimum of 2:31 passed before I could use WordStar's Find command to locate marked words and make corrections. I completed the corrections and saved the corrected file in another 1:09, a total of 3:40.

Proofreading the 3000-word file and listing all suspect words took only 1:06. Reviewing each suspect word and marking legitimate misspellings took another 2:49, a total of 3:55. Loading WordStar to start making corrections brought the total to 4:40. I had run WordStar, made all the corrections, and saved the file after a total of 6:35.

I have two criticisms of the version of Spellguard I used. The first criticism will no longer apply by the time this article appears, and the second is minor. First, Spellguard identified too many suspect words. In the 3000-word file, Spellguard found 151 suspects and there were only ten misspellings. The excess of suspect words resulted from the present dictionary's limited size, and the upcoming data-compressed dictionaries will remedy this problem.

Second, I felt a slight annoyance at having to restore the last character of each marked word (Spellguard *replaces* the last character of a misspelled word with an error mark). If the actual spelling error occurred early in the word, I thought Spellguard was entering a second error and requiring me both to delete the mark and replace it—two keystrokes plus any other corrections needed. These added keystrokes made correcting files marked by Spellguard take more time than files marked by The Word. On the other hand, by replacing the last letter of a bad word instead of adding a character to the word, Spellguard avoids disturbing the format of text in the file. You can't have it both ways.

Spellguard handles hyphenated words by displaying both halves of the word and indicating whether the word occurred at the end of a line. That makes it easy to check the correctness of both the spelling and the hyphenation. Since Microspell and The Word treat hyphens as spaces and report the broken parts of words as two suspect words, Spellguard has an advantage here. The advantage is partially offset because Spellguard reports *all* compound words as suspects. So Spellguard made "import-export" suspect, but Microspell and The Word considered the compound correct. In the 3000-word text file, Spellguard reported nine compound words as suspects; in the same file, Microspell reported fifteen hyphenated word fragments as suspects, The Word reported sixteen, and Microproof thirteen. Microproof also listed ten compound words as suspects.

The User's Guide—The user's guide for Spellguard is excellent. The writing, organized around the program's screen displays, makes its point without resorting to jargon or inflated language. A plastic three-ring binder holds 116 pages of sharp print quality, including a table of contents, an index, and a glossary. The Spellguard user's guide would probably make Spellguard the best proofreading program for general use in offices.

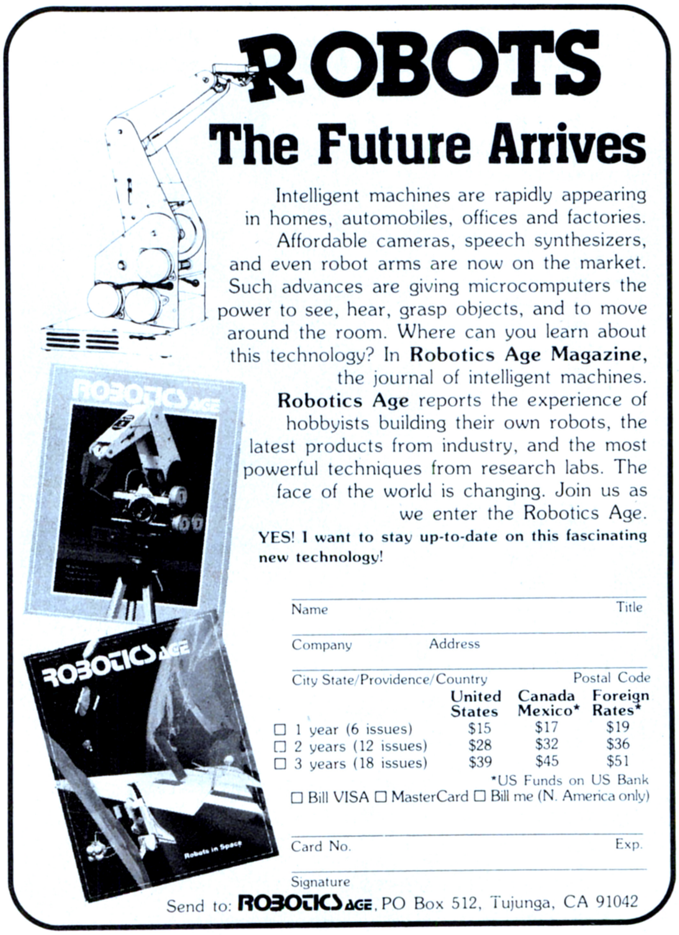
The Word Version 1.1

The Word is a program of beautiful simplicity. Its SPELL program proofreads a file and gives you a list of all the suspect words. The author, Wayne Holder, sought to create a set of tools for people who work with words. Each of The Word's seven programs is designed to meet Kernighan and Plauger's definition of a software tool: a program that is general and yet simple enough to have widespread application. Each of the seven programs works quickly and performs a valuable task. Holder envisions adding more useful programs to The Word's toolbox. For writers and editors, The Word already offers far more than just a proofreading program.

The Package—In addition to the 160 K-byte dictionary, The Word includes seven programs: SPELL (4 K bytes), MARK (2 K bytes), WC (2 K bytes), DICTSORT (2 K bytes), WORDFREQ (2 K bytes), FIND (2 K bytes), and LOOKUP (2 K bytes). SPELL proofreads a text file and lists the suspect words. MARK puts an asterisk at the beginning of each suspect word in the text file. WC counts the words in the text file. DICTSORT alphabetizes words and eliminates redundancies from the resulting list. Use it on your own text files and discover what your working vocabulary is. WORDFREQ shows you how many times you use each word in a text file, a fast and valuable check on style. FIND searches the dictionary for words that conform to a character pattern (using CP/M "wild card" characters for the unknown letters in the pattern).

LOOKUP is a remarkable little program that takes a misspelled word and "un-misspells" it, looking for words that can be derived from the misspelling by adding one letter, dropping one letter, changing one letter, or reversing two letters. The program often finds the right word and finds it much faster than you could with a printed dictionary. One new program that will appear in the forthcoming 2.0 version will let the user review the list of suspects one by one and decide whether to mark each suspect, add it to the dictionary, or ignore it. The review program will not be integrated with SPELL, so the user will have the option of listing all suspect words at once. On the more distant horizon, The Word may even include heuristics to help cope with the problem of homonyms (like "fare" and "fair") in the proofread document.

Dictionary—The Word's dictionary is large and literal.



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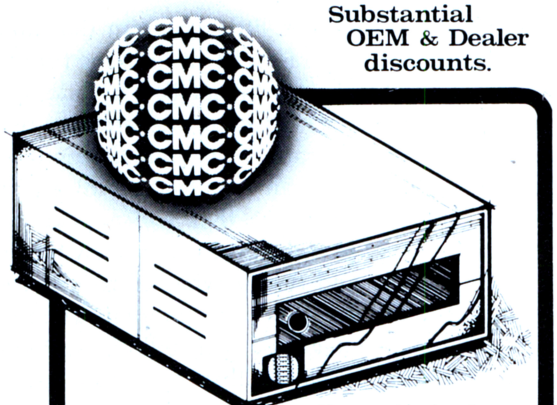

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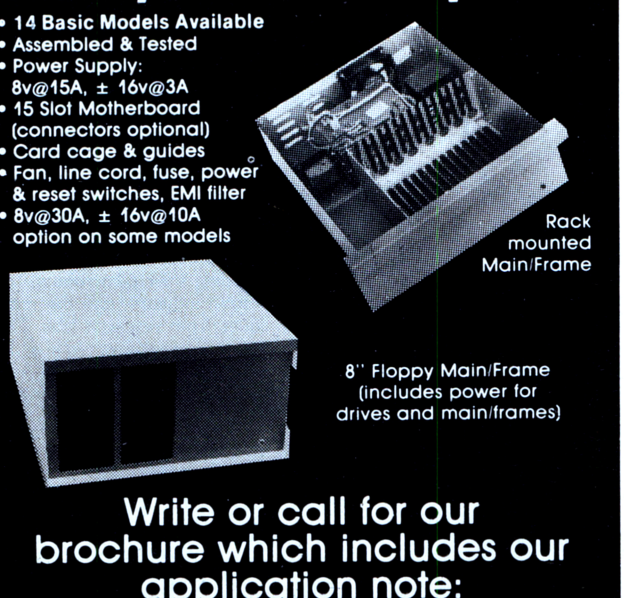

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It packs more than 45,000 words into only 160 K bytes of disk space. The Word's dictionary also uses cross-referencing to speed access to its contents. Oasis Systems based the dictionary on *The American Heritage Dictionary of the English Language* (Boston: Houghton Mifflin Company, 1979), and used data-compression techniques. One of the methods of compression is simple: when two successive words have common letters at the beginning, the common letters are replaced in the second word by a 1-byte count of the common letters. If the word "power" is stored literally, the word "powerful" is stored as "5ful." If "eccentric" is already present, "eccentricity" is compressed to "9ity." The increased dictionary size made possible by data compression pays off in a dramatically reduced number of words reported as suspect. A new version of the dictionary, using additional data-compression techniques, will soon be available. The 45,000 words will occupy only 136 K bytes and will make The Word's programs run even faster.

Performance—The Word took 1:39 to proofread the 400-word file in figure 1 and list the suspects. With the present version of The Word, you have to use your text editor to eliminate correctly spelled words from the list of suspects before marking the errors. Since The Word's large dictionary prevents SPELL from defaming many innocent words, this editing chore takes little time. Furthermore, you'll have to reload your text editor to make corrections anyway. (As noted earlier, a program for reviewing suspect words one by one is on the way.)

Here's how I used The Word with WordStar. I ran The Word's SPELL program with the $F switch, which makes The Word write the list of suspect words to a file. Then I ran WordStar and edited the list of suspect words, deleting those that were in fact correct. Next, I saved the shortened list of suspect words and, from inside WordStar, used WordStar's R command to run The Word's MARK program. Then I called up the marked text file for editing.

To do all this with the page of text shown in figure 1 took me a total of 3:15. On the 400-word file, The Word got me to the point of being ready to make corrections only 34 seconds later than Spellguard. And correcting the file marked by The Word took 24 seconds less than correcting the same file marked with the same corrections by Spellguard. The reason? It takes a few seconds more to retype the character replaced by Spellguard's error mark. The Word's mark doesn't knock out any characters, so none have to be retyped.

It took The Word 2:05 to proofread the 3000-word text file. The total time increased to 4:52 when I invoked WordStar, edited the list of suspect words, saved the shortened file of suspect words, ran MARK, and called up the text file for editing. I made the corrections and saved the file after 6:42. That's only 7 seconds slower than equivalent operations took with Spellguard.

The User's Guide—The guide to The Word is simple and clear. It separately describes use of each of the programs. Since The Word isn't organized around screen

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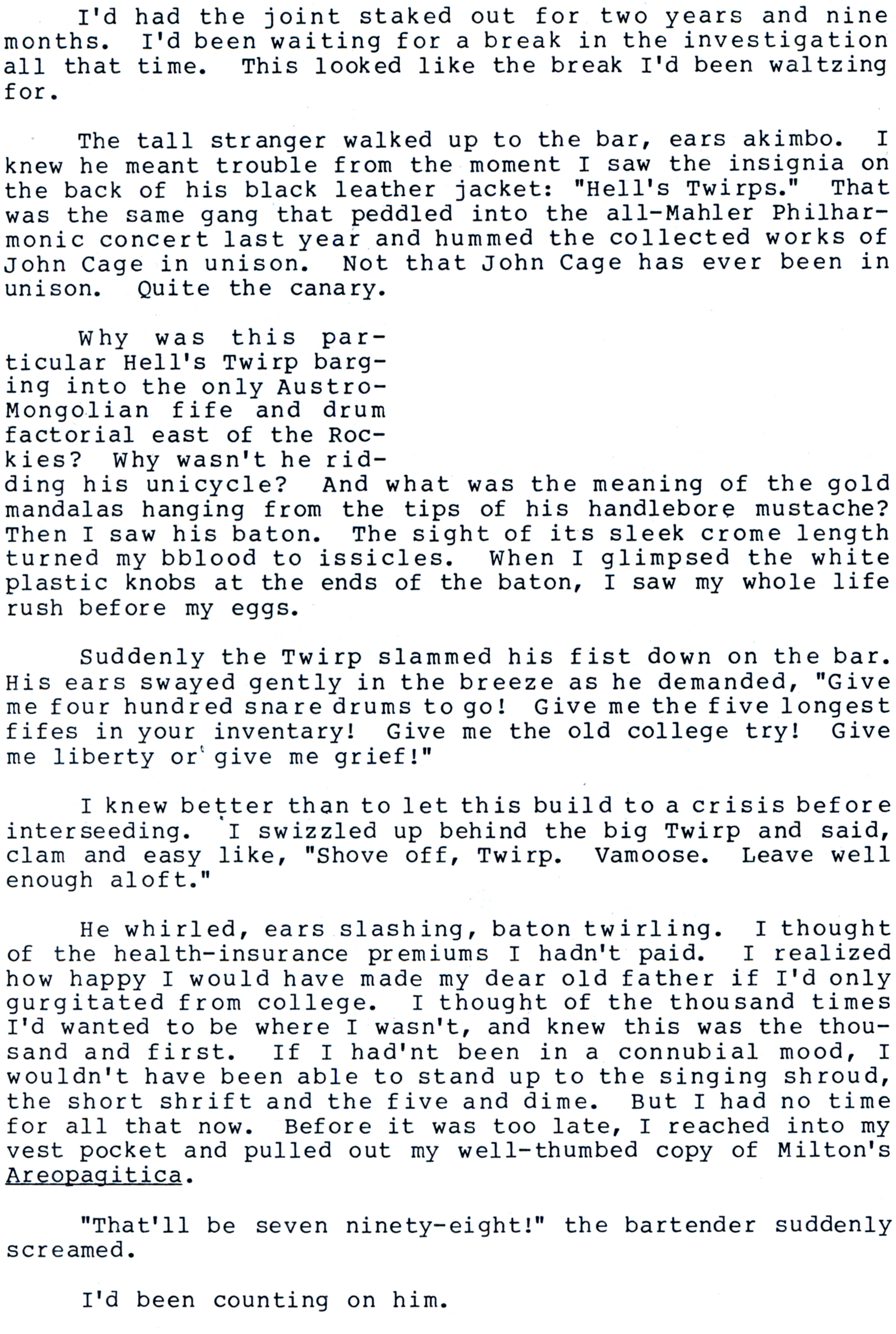

I'd had the joint staked out for two years and nine months. I'd been waiting for a break in the investigation all that time. This looked like the break I'd been waltzing for.

The tall stranger walked up to the bar, ears akimbo. I knew he meant trouble from the moment I saw the insignia on the back of his black leather jacket: "Hell's Twirps." That was the same gang that peddled into the all-Mahler Philharmonic concert last year and hummed the collected works of John Cage in unison. Not that John Cage has ever been in unison. Quite the canary.

Why was this particular Hell's Twirp barging into the only Austro-Mongolian fife and drum factorial east of the Rockies? Why wasn't he ridding his unicycle? And what was the meaning of the gold mandalas hanging from the tips of his handlebore mustache? Then I saw his baton. The sight of its sleek crome length turned my bblood to issicles. When I glimpsed the white plastic knobs at the ends of the baton, I saw my whole life rush before my eggs.

Suddenly the Twirp slammed his fist down on the bar. His ears swayed gently in the breeze as he demanded, "Give me four hundred snare drums to go! Give me the five longest fifes in your inventary! Give me the old college try! Give me liberty or give me grief!"

I knew better than to let this build to a crisis before interseeding. I swizzled up behind the big Twirp and said, clam and easy like, "Shove off, Twirp. Vamoose. Leave well enough aloft."

He whirled, ears slashing, baton twirling. I thought of the health-insurance premiums I hadn't paid. I realized how happy I would have made my dear old father if I'd only gurgitated from college. I thought of the thousand times I'd wanted to be where I wasn't, and knew this was the thousand and first. If I had'nt been in a connubial mood, I wouldn't have been able to stand up to the singing shroud, the short shrift and the five and dime. But I had no time for all that now. Before it was too late, I reached into my vest pocket and pulled out my well-thumbed copy of Milton's Areopagitica.

"That'll be seven ninety-eight!" the bartender suddenly screamed.

I'd been counting on him.

Figure 1: *The 400-word text file proofread by all five programs. Results are shown in table 3. The zaniness is intended to show the kinds of mistakes from which a proofreading program can't save you.*

displays, the guide isn't either. The programs are easy to use and the guidebook gives just enough explanation and examples.

Microspell Version 4.1

Microspell is the most interactive of the proofreading programs. Author Bob Lucas started work on Microspell after experiencing spelling problems while writing his thesis. He wanted to create a single program that gives the user fully integrated means of finding spelling errors, looks up the intended words in the dictionary, and makes corrections on the spot. He modeled Microspell after existing programs for larger computers.

Frankly, I didn't like Microspell at first because it seemed to take too long. But the more I used Microspell, the more I liked it, and the time required to run the program decreased dramatically as I became more accustomed to it. Microspell shows you each suspect word in its original context and gives you several options for dealing with suspects then and there. If you don't spell well and want to save trips to the dictionary, Microspell's Guess and Probe functions may help you find the right spelling quickly. The Probe function is much like The Word's FIND program, but Probe works from inside Microspell's large integrated program. Once you've recognized the correct spelling, you can immediately make the correction in the original text file by using the Replace command.

A coming version of Microspell will give users the ability to spread the dictionary over several disks, as well as improved logic for handling hyphenation at the end of a line (where a carriage return and line feed separate the two halves of a word). Lucas also is working on a patch program that will let the user change Microspell's defaults.

The Package—In addition to dictionary files that add up to 178 K bytes, Microspell contains SPELL (14 K bytes), BUILD (14 K bytes), INVERT (8 K bytes), and EMPTY (2 K bytes), as well as help, demonstration, and documentation files. Only SPELL and the basic dictionary (128 K bytes) are needed for most Microspell operations. BUILD incorporates a list of words into the dictionary. EMPTY gives BUILD an empty dictionary to use as the basis for a new dictionary of the user's creation. INVERT lets you view the dictionary or remove words from it.

Dictionary—Microspell's distribution dictionary contains 20,000 words in four files totaling 128 K bytes. The basic vocabulary was taken from Thorndike's list of the 20,000 most frequently used words. Two additional vocabulary files are included in the package. Called ING.VOC and ED.VOC, these files are incorporated into the dictionary if your disk size permits. ING.VOC is 20 K bytes in size, and ED.VOC is 30 K bytes. I was able to squeeze in all of ED.VOC and three-fourths of ING.VOC. That gave the dictionary 26,000 words in 154 K bytes of disk space.

Microspell's dictionary handles about the same range of words as The Word's 45,000-word literal dictionary. That's primarily because Microspell can identify words in text by stripping a suffix and checking the spelling of a word root. Microspell also accepts many plurals on the same principle. Microspell's dictionary relies on the suffix-stripping routines, rather than on data compression, to extend the range of the words it covers.

The only trouble, as the Microspell manual points out, is that the suffix-stripping routines are sometimes wrong. As an experiment, I made up some nonwords out of roots and suffixes. Microspell accepted abstractment, abhorrities, boathood, boatize, hairful, footish, mountainette, and theaterhood; it rejected discontinerary, condications, abominition, abettulate, ligamentury, nutticulate, vocabutation, writathlon, safetydom, and theatricate. In use, Microspell shows how it forms a word from root and suffix, so you can catch a mistake if you are observant and willing to check Microspell's work against a printed dictionary. But you can't correct such a mistake without exiting Microspell and running a text editor.

Performance—It took Microspell 1:06 to proofread the text in figure 1 and display a list of the misspelled words. That isn't the normal method of operation and doesn't mark or correct errors in the text file. Running Microspell in the normal way, reviewing one suspect word at a time, takes longer. The time required depends on the proficiency of the person running the program. My first few runs of Microspell were far slower than the ones reported here.

Microspell's ability to correct errors in the text file seems a big advantage over Spellguard and The Word. It took a total of 2:47 to run Microspell this way and correct all but one of the errors in the text in figure 1. (I'll say more about that one error later.) Spellguard took 1:46 to find and mark the errors, but then I had to change disks and run WordStar. Microspell proofed the text file and corrected all but one of the errors in about the same time Spellguard took to find and mark errors, plus the time needed to load WordStar and call up the marked text file. We would have to compare the 3:17 Microspell took with Spellguard's 1:46, *plus* the time necessary to use WordStar to make all the corrections in the original file and save the corrected file. Microspell's 2:47, then, has to be compared to Spellguard's 3:40. In general, Microspell has the edge on short files because the time needed to load a text editor after running the other spelling programs is a larger proportion of the total time required for the whole process of finding and correcting errors.

Except for that one special error, Microspell would have the clear advantage the correcting feature seems to offer. But that error, the nonword "inventary," was displayed as a correct word. Microspell doesn't let the user alter any word it considers correct. So I had to note the word, load WordStar, find the unmarked word, and correct the misspelling. Loading WordStar might also have been necessary if any correction changed the length of a word; such a change might destroy the text's alignment, especially if the text is justified. Microspell lost its edge because of accepting the bad word. For a fair comparison with Spellguard and The Word, add about 1:20 to Microspell's timing of 2:47. That's a total of 4:07—27 seconds slower than Spellguard and 7 seconds slower than The Word.

Microspell proofread the 3000-word text file in 2:15 (the quick way). But it took 7:15 to proofread the file step by step and make corrections. That's about 30 seconds longer than it took me to proofread and mark the file with The Word and correct the file with WordStar, and about 1:32 longer than the whole process took with Spellguard. Microspell found fifty-five suspect words, including all but one of the misspellings in the file. This time Microspell was willing to accept the word "stewardes." So I had to run WordStar afterward to correct that, and that added about 1:20 to Microspell's timing. The time required to handle this file was about 8:35 —almost three minutes slower than Spellguard and two slower than The Word. But don't forget that Microspell lets you look at the context of a suspect word and lets you probe the dictionary for a correct spelling. Those features may help you decide whether a suspect word is right or wrong, and may hand you the correct spelling on the spot, saving time-consuming trips to a printed dictionary.

The User's Guide—The Microspell user's manual contains twenty-nine pages of single-spaced, photo-offset material stapled between pasteboard covers. The print quality is good, the writing clear, and the organization sound. The manual includes a detailed table of contents, an overview of the program, summaries of the commands, switches, and error messages, and instructions for using each of Microspell's four utility programs. Two pages from a sample run of Microspell let the user know what to expect from the program. The manual's three-page explanation of the program's limitations would satisfy any consumer protection agency. A revised edition of the manual has just been released but did not reach me in time for inclusion in this review.

Microproof (CP/M Version)

If your disk space is extremely limited, Microproof may be the best proofreading program for you. On my system, I had room on a single disk for all the WordStar files, the Microproof dictionary, and Microproof's proofreading and correction programs. Furthermore, I was able to run both the Microproof proofreading program and the correcting program from *inside* WordStar. That's real convenience. And Microproof is very fast and reasonably accurate. By using root-suffix and root-prefix routines and data compression, author Phillip Manfield has made the 70 K-byte dictionary act like a literal dictionary of about 30,000 words. Manfield's inspiration? His thesis was riddled with misspellings, and someone told him it was impossible to write a good proofreading program to run on a system as small as a TRS-80 Model I. (Microproof *does* run on Model I, II, and III TRS-80s.)

The Package—The standard Microproof package includes the proofreading program MICPROOF (10 K bytes), the dictionary-building program ADDTODIC (4 K bytes), and three dictionary files that total 72 K bytes. I strongly recommend the optional correction program CORRECT (4 K bytes) because Microproof can't mark errors in the text file. Without the correction program, you'll have to type in a long search string for every bad word, using your text editor's Find function. Counting CORRECT, MICPROOF, and the dictionaries, Microproof gives a complete proofreading system that performs well and occupies only 86 K bytes of disk space.

Dictionary—Microproof's data-compression technique includes replacing all roots with one-character tokens. The dictionary is based on *Webster's Pocket Dictionary* but is not nearly that large a literal dictionary. Much of the dictionary's vocabulary comes from prefix-root and suffix-root logic. Suffix routines accepted abstractment, hairful, and footish, but rejected abhorrities, boathood, boatize, mountainette, theaterhood, discontinerary, condications, abominition, abettulate, ligamentury, nutticulate, vocabutation, writathlon, safetydom, and theatricate. Prefix routines accepted inclosed because they treat a prefix and root as separate words: "in" and "closed."

Each word is identified to the dictionary as a verb, a noun, an adverb, or an adjective, or as more than one of those parts of speech. Knowing the part of speech helps the suffix and prefix routines avoid accepting some plausible but illegitimate words.

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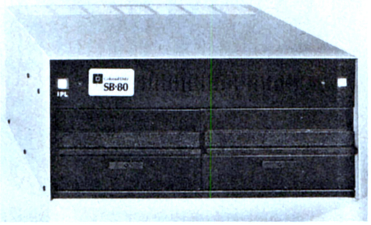

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Performance—Microproof proofread the 400-word file in only 45 seconds. The program found thirty-two suspect words, six of which were in fact misspelled. Microproof missed one misspelled word. The program's prefix routine accepted interseeding, which Microspell rejected; on the other hand, Microproof's suffix routine rejected inventary, which Microspell accepted.

Microproof recognizes some hyphenated words as single compound words and treats others as two-word fragments. It ignores all single-character words, so if you mean "I" but type "J," Microproof won't let you know.

On the 3000-word file, Microproof took only 1:09 to find 109 suspect words, including all ten misspelled words. It rejected stewardes, which Microspell accepted. Microproof's prefix and suffix routines made no errors on this file.

The User's Manual—The Microproof manual is reasonably clear, but could use refinement. Its problems, all minor, stem from the manual's need to deal with both CP/M and TRSDOS, the TRS-80 operating system. Since I received Microproof, Cornucopia has developed the manual from an outline into an adequate user's guide. The manual includes facsimiles of screen displays and the print quality is good. More and bigger staples would help the manual withstand intensive use.

Wordsearch 1.03

Wordsearch is the only noncontender in the group of proofreading programs.

The Package—In addition to its dictionary (72 K bytes), Wordsearch includes the programs SEARCH (10 K bytes), WDS, WDL, WDA, WDT, WDM, and VIEW. All but SEARCH and VIEW are 4 K bytes in size, and VIEW is only 2 K bytes. SEARCH works by letting you access the smaller programs. It uses WDS to scan a text file for suspect words, WDL to list the suspect words, WDA to assign each suspect word to one of three groups, WDT to display the text file with suspect words highlighted, and WDM to merge good words with the dictionary. The reason for displaying the text with suspect words highlighted is mysterious, because all you can do is look; you can't reassign or mark the words.

Wordsearch provides no means of either marking suspect words in a text file or correcting misspellings. As

My Hardware

I ran the proofreading programs on my SuperBrain computer. My timings are slower than some of those advertised for the programs reviewed, but that doesn't mean the advertisements were false. On systems with larger disks or hard disks, all the programs should run faster. For SuperBrain users who have one of these programs but can't match my timings, the operating system I use (SB/E, from IE Systems of Newmarket, New Hampshire) performs disk operations about one-third faster than the standard SuperBrain operating system. Also, do not try putting the larger Spellguard dictionary or The Word's dictionary on a single disk. My operating system can handle 188 K bytes per drive, opposed to the standard 161 K bytes.

a result, the user has two choices. The first is to print on paper a copy of the entire text file with confirmed misspellings underscored (or in bold or surrounded by double parentheses, at your option). For a text file of any size, the time required for printing, unless you have an extremely expensive printer, is sufficient to prevent Wordsearch from being competitive with other proofreading programs. Furthermore, after the file is printed, you have to work from the printed copy while using a text editor on the original unmarked file. Visual checking between paper and screen is time-consuming and far less accurate than using the search command of a text editor. Besides, if you'd been satisfied with the efficiency of working on paper, you wouldn't have bought a computer in the first place.

The second choice is to have Wordsearch print an alphabetical list of confirmed misspellings. This way, you need less time to print, but you have no idea where the errors are located. So you work with the text editor's search command. But that poses problems, too. Since Wordsearch doesn't use a mark character, you have to type the full misspelled word when you use a search command. That requires more checking between paper and screen and raises the possibility of making a typographical error when entering the string to be searched for. To make matters worse, since the list of misspelled words is alphabetical rather than in the order of occurrence in the text file, you often have to return to the beginning of the file to start the next search (or else use a global search, which is slower).

Wordsearch might deserve reevaluation if Keybits added a large dictionary and a means to mark errors in the original text. Unfortunately, Keybits plans no major changes in Wordsearch in the near future.

Dictionary—The dictionary I received with Wordsearch contains 7200 words in 72 K bytes. Rather than making the dictionary from a list of the most frequently *used* words, Keybits worked from a list of the 10,000 most frequently *misspelled* words. As a result of this approach and the dictionary's small size, Wordsearch considers the following words suspect: arm, baby, calm, catch, choices, assets, businessmen, chief, cover, dark, eyes, dinner, doubts, knew, land, life, thought.... You get the idea.

Why did Wordsearch take this approach? The user's guide says, "...ones [sic] written word vocabulary is a major subset of his total word vocabulary and varies from person to person. It is for this reason that we have provided a starter library of several thousand words, many of which are variations on the same word...Over time however, it will be necessary to add fewer words in order to stabilize your own tailored writing environment." If you can ignore the redundancies and mixed metaphors and somehow live with the knowledge that your environment has learned to write and tell the world what you're really like, you can get the message: Wordsearch assumes that everyone will write his or her own dictionary. Al Clark of Keybits says that after three months of adding words to the dictionary, the average

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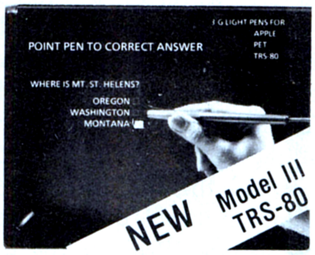

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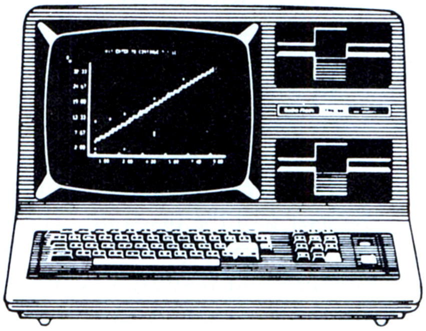

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user can expect Wordsearch to report only one or two suspect words each time it's run. Keybits has a 50,000-word dictionary on disk, but Clark says there has been no demand for it from Wordsearch users.

If you consider yourself in the same league with Samuel Johnson, Noah Webster, and the *Oxford English Dictionary*'s Dr J A H Murray, and if you have three months to devote to writing your own dictionary, Wordsearch is the proofreading program for you. But if you want to buy a program today and proofread a letter tomorrow, Wordsearch won't help you much.

Performance—In the 400-word text file, Wordsearch found 105 words suspect. It listed the suspect words on the screen after only 55 seconds. But the list was of little use until I'd used the assign option to confirm which words were misspelled and then used the text-display option (with the /OY switch) to print the file with the misspelled words underscored. Using the assign option took 2:55 to review the 105 suspect words. Printing the file brought the total elapsed time to 4:11. Making the corrections with WordStar and saving the corrected file took another 1:37, for a total of 6:13.

Things were worse when I used Wordsearch to proofread the 3000-word file. Wordsearch needed only 1:06 to proofread the file and list 517 suspect words on the screen, but it took me 8:15 to assign these words to one of three groups. Printing the whole file with misspellings underscored took more than 11 minutes. I abandoned that approach and started over. This time I just had the program print a list of confirmed misspellings. That took only 15 seconds, so I'd saved almost the full 11 minutes. But when I edited the file and used the search command to locate misspellings, I had to type in each string exactly. Since the list was alphabetical, I often had to return to the start of the file to initiate a new search. Alas, making the corrections and saving the file took another 3:28, so the total came to 13:49—roughly double the time required by any of the competing programs.

The User's Guide—The Wordsearch User Manual is incomplete, overwritten, and poorly organized. It stands as a Great Wall between the user and the program. The introduction says, "To take full advantage of this manual, begin by trying each function and feature at your terminal as you review it in the manual." A careful check revealed that my terminal was *not* in the manual. The system overview begins: "Wordsearch is a spelling word dictionary lookup system." That sounds like an attempt by a word, miraculously blessed with the ability to spell, to look up a dictionary. The Wordsearch User Manual sells for $45. I'll bet the National Museum of Obfuscation, Redundancy, and Misplaced Modifiers would pay twice that amount for it!

Conclusions

Spellguard, The Word, Microspell, and Microproof should all win a place in the market for automatic proofreading software. Which program is best for you? That depends on which features you consider most important.

The Word and Spellguard are the most accurate programs because they use literal dictionaries. At this writing, The Word's dictionary is larger and occupies less disk space.

Spellguard, once its larger dictionary appears, will probably be best for the office because of its menu-driven operation. But The Word merits consideration there, too, because all its operations are so simple.

If you want your computer to look through the dictionary and propose alternatives to a misspelling, choose between Microspell and The Word.

If you prefer a single integrated program that does everything from proofreading to guessing the intended word and correcting the error in the original file, you'll go for Microspell. Because of its suffix-stripping routines, Microspell is slightly less accurate than the packages with literal dictionaries.

If you have limited disk space, Microproof offers big-dictionary performance through data compression and suffix-prefix routines, at some sacrifice of accuracy.

If you want a good proofreading program, but also want other features useful to writers and editors, you'll buy The Word.

My own preference? I like great accuracy, a large, literal dictionary, and a marking feature. I also like a program that can look up words in the dictionary on disk. Furthermore, I like to see a list of all suspect words at once. Since I'm a writer and editor, I find word-frequency software useful, and I'm usually short of cash. By far the least expensive of these programs, The Word has no shortcomings I've been able to find. I've already mailed my check for $75 to Oasis Systems.■

[*While correcting the proof of this review, I received version 2.0 of The Word and I couldn't resist testing it. On the 400-word text file, it found the same number of suspect words as before, but the program works faster now. The Word took only 1:28 to proofread the file and list the suspects. The new REVIEW program eliminated the need to use WordStar to edit the list of suspects. With REVIEW, I needed only 26 seconds to review the suspects, and only 7 more seconds to mark the confirmed misspellings. I had loaded WordStar and was ready to correct after 2:46. I completed the corrections and saved the file in only 3:31.*

On the 3000-word file, The Word 2.0 showed improved handling of WordStar's soft hyphens. As a result, it found only 38 words suspect, only 28 wrongly so. Moreover, The Word 2.0 proofread the file and listed the suspects in only 1:43. REVIEW enabled me to review the suspects in 31 seconds; MARK marked the confirmed misspellings in 28 seconds. (Reviewing and marking took 2:49 with Spellguard, but only 0:59 with The Word 2.0; the short list of suspects helps a lot.) I had loaded WordStar and was ready to correct after 3:27. It took another 1:50 to make the corrections and save the file, for a total of 5:17. For combined speed, convenience, and accuracy, I think The Word 2.0 has far surpassed its competitors. And it still costs only $75.]

New Software, New Hardware Computer Languages, and Games

Jerry Pournelle
c/o BYTE Publications
70 Main St
Peterborough NH 03458

"Read any good books lately?" asked my mad friend Mac Lean.

Having just come back from an autograph party for *King David's Spaceship*, and the day before sent off the copyedited manuscript for the new Niven-Pournelle *Oath of Fealty*, I knew what to say. "Haven't had time. But I've *written* some good books lately...."

"Yeah, well, I wasn't talking about science fiction," said Mac Lean. "I meant good books on computers. I've got a dilly." He held up *PL/I : Structured Programming*, by Joan K Hughes.

"Hey, I know her," I said.

"Well, you tell her for me she's written a really top book. Good index. Clear English. Stand-alone chapters, so you don't have to thumb back and forth to find out what's going on."

"I'll do better than that," I said. "I'll tell my readers."

"Yeah. Sure. When?"

"Uh, real soon now...."

* * *

My apologies for taking so long in finishing this column, and my thanks to all of you who've written encouraging letters. Things do get hectic here at Chaos Manor, and the last few months have been something to see: books to get done, articles to write, and I built a new wing on the office, which meant moving everything around like Chinese Checkers, which meant that I lost the documentation to half the software sent me for review, which—

I am also, for my sins, Chairman of the Citizens Advisory Council on National Space Policy, which involves chairing meetings and editing papers and writing summaries and flying to Washington. The result was that for a good while I had no time to play with Ezekial, my Z80, but things are a bit caught up now, and maybe we can get onto a schedule. Just last week I had a surgeon remove the telephone from my ear.

One reason we got caught up was Spellguard.

Every now and then you find programs that do things right and have documentation that tells you what to do and how to do it—programs that are a joy to use. Spellguard is like that. (See the reviews of Spellguard, Microspell, the Word, Microproof, and Wordsearch on pages 434-448.) Spellguard finds spelling errors. That's all it does. It doesn't wash dishes, or set your clock, or do your taxes, but wow! can it find spelling errors in standard ASCII text files. And it doesn't care what editor you used to create the files.

Using Spellguard is simplicity itself. All you do is tell it what file to look at. It does the rest. It does *not* do it as fast as the ads say—at least it doesn't with Zeke, but then he's only running at 2 MHz, and my ancient iCom drives, while utterly reliable, are pretty slow. Help is on the way: I've got a pair of Lobo's 8-inch drives, and they've promised an S-100 double-density controller next month. If the controller is as fast and reliable as their drives, things are going to hum around here. We've been using Lobo drives (both 8-inch and 5¼-inch) on the boys' TRS-80 for months now, and we love them.

Meanwhile, Spellguard runs fine under Speed, a rather strange program available from the CP/M User's Group. Speed trades memory for rapid disk I/O, and if you have programs that don't use a lot of memory but have a lot of disk operations, Speed can cut running time dramatically. For Spellguard the saving is about 50%; the saving in posting my journals to ledgers is even more dramatic—70%.

Speed, with auxiliary programs to get it running properly, is available on Volume 38 of the CP/M User's group (CPMUG) disks. Those with access to a computer net may be able to find it in an on-line file. You need a bit of patching with DDT to install SPEED, but the documentation (also on CPMUG Disk 38) is clear enough.

One warning, though: Speed maintains the disk directories in RAM (random-access memory), and if you change disks without rebooting (in Speed that's control-B, rather than CP/M's control-C) the result is an unmitigated disaster!

But back to Spellguard. When you run Spellguard, it first gives you a table, telling you how many words it has read, the number and percentage of unique words, the number and percentage that it can't find in the dictionary, and finally a changing column that tells you the percentage of proofreading the program has done.

Many years ago, when I was young and impressionable, I fell under the spell of a science fiction writer named A E Van Vogt; later he became a friend, neighbor, and colleague. Van Vogt was (and still is) interested in a rather hard-to-define field of study called general semantics, and through him I was led to Alfred Count Korzybski and a strange book called *Science and Sanity*. That led me to Wendell Johnson at the University of Iowa. Professor Johnson's interests spanned everything from classical linguistics and speech therapy to general semantics.

One of Johnson's research interests was identifying text: how could you tell if an anonymous work had been written by a particular author? Dr Johnson used a number of quantitative measures, two of the most important being the type/token ratio and the verb/adjective ratio. Type/token means the ratio of unique words to total words; verb/adjective is self-explanatory. I remember going nearly blind counting total words and making tables of unique words in, for example, Marlowe's *Duchess of Malfi*; the idea was to find out if Marlowe had written any of the Shakespearean plays. (As best we could calculate, he hadn't.)

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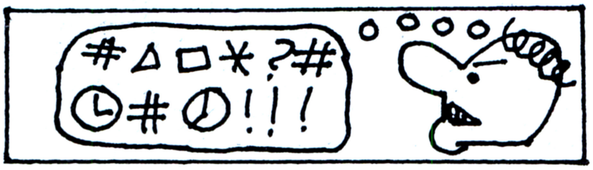

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Now Spellguard gives you automatic type/token ratios, and if you really want to, you can make up separate verb and adjective dictionaries, thus finding the ratio merely by typing in the text, which, believe me, is a great deal easier than doing it in teams of two with pencil and paper. Spellguard, with its efficient search algorithms, could be extremely useful in linguistic research projects.

Anyway, if you work with text at all, you'll love Innovative Software's Spellguard. It is an example of excellent software: a program that does one thing, does it very well, and has documentation to match.

Datebook and Milestone

Organic Software of Livermore, California, has also produced two excellent programs that I recommend, although I'll probably never use them.

The first, Datebook, can keep track of about six months' worth of appointments for three people. We had no trouble getting it to run, and it seems to be easy to use. The main drawback is that you have to *want* to run it; Datebook requires both disk drives and all of your microcomputer's memory. What I want is Calendar, a program that I may have to write myself; it would come up when I turn on my system, insist that I give it the date (the way Lobo's LDOS operating system does), and then natter at me about what I have to get done. But it's fairly obvious that I can't write *that* program until I have hard disks with multimegabyte storage.

Calendar would solve my problem: I forget to look at my appointment book until it's too late. And that raises a question: is Datebook really better than an appointment book of the kind used by many physicians and lawyers? I can't answer that, but my guess is that I wouldn't buy a computer for that *alone*. Datebook has various search patterns, so you can look for appointment openings of stated lengths, and the program offers up to nine candidates—but you can do that by glancing at a book, too.

The value of Datebook is that it will keep three schedules simultaneously, so you can work appointments with your partners (it searches for times when you're all free). It will also search through and find all the appointments you've made with a particular person—a task that is more difficult and certainly more tedious if you must rely on visual inspection of a book (especially if there are a lot of entries). And of course Datebook can make hard copy, and update that often. All in all, if I worked in a business where I had lots of appointments and schedules, I'd probably use Datebook, but then I'm gadget-oriented—and I *have* a computer.

Organic's other interesting program is Milestone, and people who need it will like it a lot. Milestone is a PERT-chart generator. It performs critical-path analysis for jobs with up to 300 tasks; it computes milestones (critical events), monthly manpower levels, monthly costs—in short, it handles most of the details we used to have to include in the management-plan portion of a research proposal.

Milestone isn't easy to use. In fact, it's almost impossible to use on my system because I don't have a 24 by 80 terminal. I use a memory-mapped 16 by 64 video display, in part because I still use the old-fashioned Electric Pencil as a text editor, and Pencil requires it, in part because I like the smooth scrolling and fast response, and in part because I'm lazy and have never gotten around to buying a terminal. That's going to change one day.

Anyway, Milestone isn't easy to use, not because the directions for the *program* aren't clear (they're only fair), but because PERT charting and critical-path analysis are more arts than sciences, and not easy jobs. Milestone can make the jobs easier, and if I ever again have to generate research proposals, I'll certainly use Milestone.

One of my pet peeves is documentation without examples. I can't imagine why people write instructions on how to use a program but fail to include specific illustrations of what command to issue and the results.

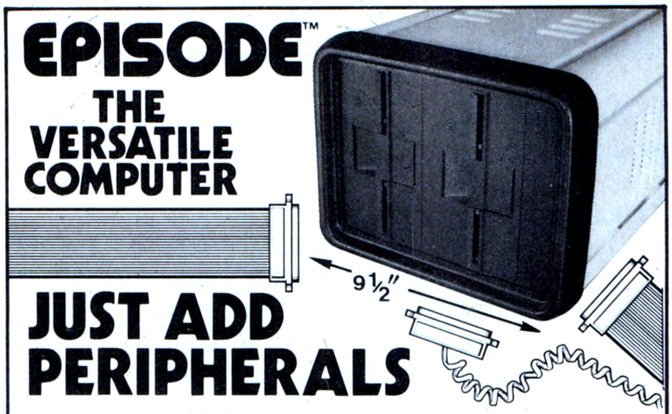
Let me illustrate. Suppose I am opening Milestone after not looking at it for a couple of weeks (as indeed I am). I turn to page 36, and there I find:

> "B(egin) and E(nd) work
> These two values define when the normal working day begins and ends. They must be even hours as defined on a 24-hour clock. Follow the rules for entering integers rather than times."

Now I ask you, what does this mean? Presumably, I once knew, but I confess I've forgotten. Indeed, some of us go days on end without even thinking about computers!

I don't want to be too hard on Organic; Milestone, in fact, comes with a set of example cases. One is Dr Victor Frankenstein III's PERT for creating a monster. Event One, "Fanatic Desire to Create Life," is a milestone; it has no duration, but you don't start without it. We proceed to Task Two, "Move to ancestral castle," and continue searching for Grandfather's notes, hiring a linguist, etc. As it happens, Organic ran this example as part of a demonstration for me at the San Francisco Computer Faire, and I can testify that Milestone is both fast and accurate. I thought up the need for a linguist to translate the notes. That broke into subtasks: advertise, interview, hire. I watched Burns VanHorne of Organic enter the new tasks. Milestone thought for a moment, then rearranged itself, because this information became part of the critical path. (Not long ago they sent a revision of Milestone and I notice that the tasks I suggested are now in the case study.)

So they have examples, in the sense of worked-out problems for their program, but they should have in-



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cluded specific examples all over their manual—and so should every other publisher. Please?

Debate on Languages

My last column, on languages, generated a lot of correspondence. Some was predictable: I wasn't sufficiently respectful of LISP, the LISt Processing language written in 1956 by my friend John McCarthy, and since improved and expanded by McCarthy and my collaborator, Marvin Minsky, and used by my friends and associates who wrote ZORK, and—in other words, please, I don't dislike LISP users.

What I said was that LISP was fine for special purposes, but it wasn't among the candidates for replacing BASIC.

For those offended, my apologies, but I remain unrepentant. LISP may indeed be a great language for professional programmers, as it certainly is for those working in artificial intelligence. Furthermore, if you're someplace where you can learn LISP easily—say MIT or Stanford—then by all means grasp the opportunity.

Most of us, though, don't have that opportunity. Even if you have access to MIT's LISP-teaching programs, it's going to take time—lots of time—to learn. The ideal way to learn LISP is to use it; it does have the great feature of being an interactive language (which is BASIC's great advantage). But the LISPs available for microcomputers are very limited (Minsky himself wasn't able to do much with the one I have), and it isn't likely that they'll get better—not with our present hardware. Come the revolution, when 32-bit machines with 256 K bytes of active memory and 50 megabytes of disk storage can be bought for $2000, LISP may then be the best thing available, but not now, unless you have very specialized needs.

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In any case, this remains the *User's Column*, directed in large part toward nonprofessionals who are trying to make their small systems do useful things, and for those readers I don't recommend LISP. It can be fun to play with, and I'm glad Microsoft published it, but I doubt that microcomputer users will ever do more than play with LISP.

But the problem of languages has yet to be solved.

In theory, BASIC is an inadequate language. Listen to the hackers: they'll tell you that BASIC programs "are a maze of GOTOs" or that "you can't do structured programming in BASIC."

That isn't true. A good modern BASIC—say Microsoft's BASIC-80, or Software Systems' CBASIC—has *do while*, *if-then-else*, *case*, and nearly all the features Pascal has, plus string features that are a *lot* better than any Pascal I've seen, and decent I/O, which Pascal doesn't have at all. True, there are problems in BASIC that are easiest to solve with judicious use of GOTO statements, but it's certainly possible to write good BASIC programs without a single GOTO, and even easier to tame the GOTO so it never refers to anything outside a local modular block.

You *can* write top-down structured programs in BASIC. Best of all, you can write interactively, testing each step of the way, then test the program logic until it's working, after which you turn it over to Microsoft's BASCOM compiler, and wham. And for maybe 80% of the jobs you want a microcomputer to do, that's the best approach. It's almost certainly the fastest.

So what's wrong with it?

Plenty. First, BASIC still has a fatal flaw—no truly local variables. Passing parameters to a subroutine is hard, and controlling side effects (making sure you don't do something you didn't intend) isn't easy. You can reserve I,J,K,L as indices and set up "declarations" in remarks up at the top of the program, and with the new cross-reference programs you can *usually* find the side effects. Having done that, you still have trouble passing parameters, and if the program gets big, so that you'd like to compile it in chunks, you're out of luck. BASCOM doesn't permit decent chaining of programs, nor does it allow true compilation in parts.

In fact, the Microsoft BASCOM is not really the same language as its BASIC-80. In addition to the chaining problems, you can't use computed array sizes or common statements.

"But," protests the BASIC enthusiast, "that can be

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fixed. In fact, I bet you somebody at Microsoft is working on it right now."

True. And maybe, one day, they'll really fix the BASIC/BASCOM system. I hope so, because I find BASIC programs fairly easy to read and write. I expect you'd be able to buy a lot of programs in compiled BASIC right now if it weren't for Microsoft's disastrous policy of demanding royalties for every program compiled with BASCOM. Competition will take care of that; meanwhile, I use BASIC-80 with BASCOM for routine jobs, and a lot of my most useful programs are written in CBASIC.

There's so much investment in BASIC software—take Joan Hughes, author of the PL/I book that so impressed Mac Lean. Joan runs Execudata, one of the first of the small-systems houses that have sprung up everywhere. She sells turnkey systems for small businesses. The hardware she favors is the Vector Graphic S-100 bus Z80 with its "mindless terminal," which is really memory-mapped video. The software comes from all over. The editor is Vector's, and I'm tempted to buy a Vector machine just to get it; it's a lot like Electric Pencil but with most of the bugs out. Execudata writes other software or buys it commercially. Like all first-rate systems houses, they support everything they sell, and their customers seem downright enthusiastic.

The interesting angle is that the author of the best book we've seen on PL/I sells software largely written in CBASIC.

Why? Execudata has been around several years. When Joan first started the company, there wasn't a PL/I for microcomputers and CBASIC was the only BASIC that allowed long variable names (remember the horrible days when variables were "A$" and "B1" and you hadn't the foggiest what they referred to?) and structured concepts. She may change over, now that we have PL/I from Digital Research.

Digital's PL/I documentation is, if nothing to brag about, at least readable. PL/I-80 is a fairly healthy subset of the ANSI General Purpose (Subset G) PL/I, and it runs.

"Yeah, and so what," asked a friend. "Who'd use it?" "PL/I is unwieldy and inefficient," says a recent article in a magazine. On the other hand, Mac Lean has spent the last couple of weeks learning it and he loves it.

Meanwhile, I have—at last!—gotten not one but two Pascals that run, and I've been wading through Peter Grogono's *Programming in Pascal* (see references) and reading everything I can find on Pascal.

I recommend Grogono's book—for that matter, I recommend the Pascal/MT+ implementation of Pascal. It works, and unless Mike and Nancy Lehman have become liars, which I doubt, Pascal/MT+ is a full implementation of the Standard Pascal, along with a few much-needed extensions.

Their manual is improved, too. (They sent me an early copy, and apparently my anguished screams were too much for them.) They've added a number of sections, and, according to Nancy, "That's all because of you...."

I also have the Sorcim Pascal/M up and running. Pascal/M compiles to an intermediate code. It's slower than Pascal/MT+, but it's also more compact and more portable. It, too, has extensions to standard Pascal, and I recommend it.

What I don't recommend is Pascal itself. Not yet, anyway. When I first looked at Pascal several years ago, I thought it was the nicest thing I'd ever seen. But the more I look at it, the more misgivings I have. I certainly could be wrong, and I'll know more by next column time. And by then, Mac Lean will have done things with PL/I so we can compare notes.

Meanwhile, don't throw away your CBASIC; *they've* made some improvements, also (Compiler Systems' President Gordon Eubanks says) as a result of my reviews. The needless limit on the line printer width has been fixed, and the COMMON and CHAIN features improved. I think the latest version has some other improvements, too, but I've mislaid the new manual. Although I've said it before, it's worth mentioning again: the CBASIC documentation is excellent.

Gordon also tells me that by the time this is printed there'll be a new version of CBASIC that allows nested IF

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statements (fixing one of Joan Hughes's pet complaints), and before the end of the year they'll have parameter passing and local variables, and they're working on speeding it up.

The language situation isn't our only dilemma. Let's face it, our microcomputers are becoming obsolete. In one sense that's silly: we have more computing power than the government did ten years ago. The machines work reliably. And there's no point in replacing our machines just when we're finally getting good software.

But that's the problem: we're beginning to see hardware limitations on the new software.

Take Spellguard for instance. It's a good program. I use it often. But it can't touch *real* spelling programs like those that run on the big MIT computers. MIT's Spell (written, incidentally, in LISP) not only finds misspelled words—it shows you the word along with context, shows a menu of words it thinks might have been meant, offers you a chance to enter the new word in your permanent dictionary (if that's refused, offers the opportunity to put it in a dictionary kept just for this job), and, finally, lets you input the proper spelling, which it inserts into the text. It does all this at blinding speeds, searching dictionaries of 35,000 to 50,000 words. No 8-bit machine running floppy disks can touch that job. [**Editor's note:** *Don't be so sure, Jerry. See the review of spelling programs in this issue.* ...**PL**]

There are other limits. One controversy over text editors hinges on a simple forced choice: do you limit the amount of text you can work on to what can be held in memory (as Pencil does), or do you keep part of it on the disk (as WordMaster, WordStar, and Magic Wand do)? If you keep part on disk, you can't conveniently change disks: that can be a serious limitation if you want to bring in a chunk of an old file or make a quick copy of something you can't afford to lose. If you keep all the text in memory, not only are you confined to 10,000 words or less (with my system, anyway), but you encounter real problems if you want windows and multiple buffers or if you'd like the machine to do some computing on values in the text.

Obviously, I prefer Pencil's limits. I have Wand and WordStar, but I don't use them—Star because it natters at me (when was the last time you wanted to know line and column number every time you typed a letter?) and Wand because of the disk operations. (Word Master, on the other hand, is the best programming editor I know of.) None of the available editors, not one, can do what I'd really like them to—for instance, let me put equations in my text, solve them, and have the answers available as I write. (What I usually do is leave the text on the screen and turn to my programmable TI-59, and that's silly.)

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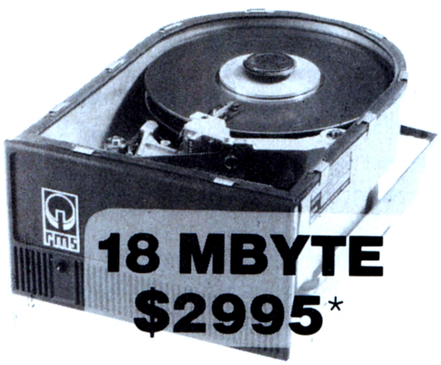

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Yet what I want isn't impossible—for big machines. MIT's MACSYMA can solve intricate equations, and its EMACS editor is inherently more powerful than anything we can implement on a microcomputer. I haven't seen them combined, but it wouldn't be that different if the memory was available.

New Machines

For a few years we'll exploit what we have, but it isn't going to be long before Zeke becomes the world's smartest terminal (two memory-mapped screens, a 20 K-byte PROM monitor to control printing and I/O, etc), while a new machine does the work. Only—what will the new machine be?

Two years ago everyone would have said "the Z8000." Now we just don't know.

Next, when we get the new machine, what will we use for an operating system?

Again, two years ago everyone would have said "UNIX, of course." And if we had UNIX, which is a fairly complex tree-structured operating system developed by Bell Laboratories, we'd also have answered the language question, since UNIX contains a C programming-language compiler and is written in C.

Now, again, we just don't know.

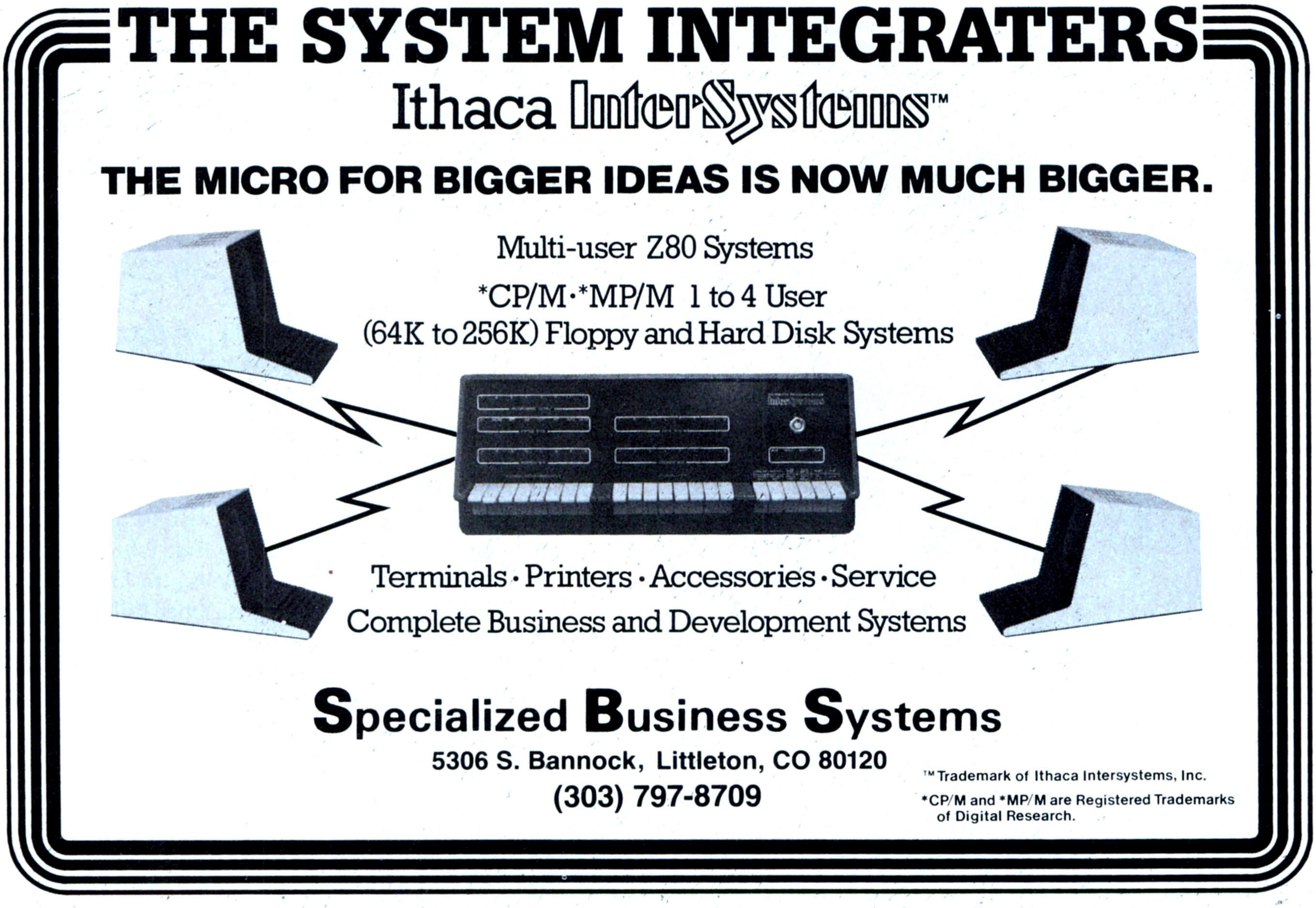
What went wrong?

First, there weren't any reliable Z8000 chips. Now that problem's fixed—but there aren't many available Z8000 computers, are there?

There is one. Onyx has a working Z8000, with UNIX and C, hard disks, and 128 K bytes of memory. They're being shipped as fast as they're being made, and according to their customers they work and work well. There's a good chance I'll have an Onyx running here in a few weeks and I'll be able to tell you a lot more.

Meanwhile, there's a serious rival to the Z8000 and UNIX: the dual 8085/8088, working on an S-100 bus and running Digital Research's operating system that looks a lot like CP/M and allows you to bring over most of your CP/M files. The 8085/88 won't run Z80 code, but then neither will the Z8000. It does execute 8080 code.

Bill Godbout sells an 8085/88 system, and Tony Pietsch, the engineer who built my system, recommends it, along with hard disks and dual-sided double-density floppies to back up the hard-disk system. Tony is building a Godbout S-100 system and there's a chance I'll get one for review. The Lehmans use a Godbout S-100 8085/88 system for their Pascal/MT+ and they're very happy with it, while Sorcim's president Richard Frank says they've got half a dozen running constantly and that you can pitch the Godbout box out a second-story window without hurting it.



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In other words, Z8000 with UNIX has respectable supporters, and so does 8085/88. Prices aren't quite comparable: the Onyx system costs more, largely because of the UNIX software, which isn't cheap. Performance isn't comparable either: the Z8000 Onyx is much faster than the 8085/88 machines.

Fortunately, we don't have to make any decisions just yet. It may be that the best policy is to skip all the 16-bit machines entirely and wait for a new generation of 32-bit monsters. Certainly if you're contemplating buying your first system, go ahead and get one: I still recommend the S-100 bus and Z80. You can upgrade to dual-density floppies and hard disks without *too* much risk, but if you want a system to *use* rather than play with, be conservative and leave systems development to the Tony Pietsches of this world. (Notice that if I get new systems in here, they'll be in addition to Zeke; him I don't touch.)

And stand by. Exciting things are happening in microland.

* * *

I like computer games. I'm fond of ZORK and the various Automated Simulation games, and now they've got a new one called Star Warrior that's guaranteed to use up more time than you thought you'd give it, especially if you're a fan of Heinlein's *Starship Trooper*. The game has a lot of the same appeal as that book. It's played in real time, and you jump about in space armor trying to wreak havoc on the dastardly enemy while avoiding death. And it's balanced: you usually get out alive, but just barely.

I'm a Star Warrior addict. The boys like ASI's Hellfire Warrior, which is an extension of their famous Temple of Aphsai. They also like ASI's Rescue at Rigel, which is Dungeons and Dragons in spacesuits. I expect I'd like them too, if I had time to play them.

However, I'm not enough of a masochist to play Scott Adams's Adventure International games. There are those who like Scott's games a lot. Certainly, they aren't easy. Unfortunately, for me at least, they're just too tough. For example, he's got one called Balrog Sampler (it also has the title Maces and Magic #1 on it), a vastly complex game requiring two 5¼-inch disk drives. Like Automated Simulation's Temple of Aphsai, when you enter the game it generates a random character for you, after which you buy weapons, armor, and the like, before setting out.

Unlike ASI's games, Adams's game gives you no choice. You *have* to accept the characters randomly generated for you and a scruffy lot they are. But don't worry—if you're lucky enough to get one who's strong as Superman and rich as Croesus, he's still going to get killed about the time you get interested in the game. *Everybody* gets killed in Adams's dungeon, and often unfairly. In Zork and Adventure there's some logic to the puzzles, but in Balrog various things pop up and kill you before you can run away. There's one room in his dungeon where you find an attendant and a wheel of fortune. If you don't play, the bouncer comes and kills you. If you do play, you lose.

There are other "puzzles" in Balrog, but all of them are inexplicable—at least to me—and I always get killed. So do the boys, and one of them is an experienced (and fanatical) Dungeons and Dragons player, so it isn't just my amateur status.

It wouldn't be so bad if you could just play, get killed, and start over, but since the game is in BASIC (with encrypted messages and all kinds of kludges to keep you from analyzing it) it takes forever to initialize, load, create a character, and go through the ritual of choosing weapons and armor, just so you can get killed two minutes later. The dungeon keeps score and the program alters itself after every expedition so that when next you play, the dungeon proudly displays the number of players who have entered and the number killed. Ours is up to about 25 for 25 now, and nobody in the neighborhood wants to see the game again.

Meanwhile, Workman & Associates continues to sell the original Crowther and Woods Adventure for CP/M systems (see my review, December 1980 BYTE, page 230), only now they've added a twist.

"Only with our Build-an-Adventure Kit can you truly build an Adventure," the Workman copy reads, and I guess that's nearly true. The "kit" consists of an Adven-

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ture data base and instructions for altering it or, if you like, starting over with everything new.

The data base contains a travel table (description of each room, where you can go from there, and what commands get you where); the vocabulary (five-letter or shorter words that the program will recognize); initial conditions for various rooms (light, water, oil, etc); messages, objects, including their initial location and whether or not they can be moved; treasures, which are a kind of object; and various other stuff.

It's amazing what you can do with it. For example, you can specify that to get from a room, say BEDQUILT, to another, say SWISS CHEESE, you will be successful 25% of the time if you go East, but always if you go Up, or that the travel will fail if you are not carrying the skull, or that it will fail if you *are* carrying the skull. You can automatically transfer from one room to an identical room (identical to the player), except all commands work backward in the second room, or there are extra objects and doors.

In the actual Adventure game this is done a lot: for example, there's a room with a live dragon standing on a carpet and another with a dead dragon lying near a carpet. Most players think it's the same room, since it's the same location, but in fact it's not. In the first room the carpet isn't real: it's part of the room description. If you tried to take it, the program would say "I see no carpet here" if the program wasn't instructed to issue messages about the dragon only. In the second room, the carpet is real, and so is the dead dragon, except that you can't "take dragon" successfully because he's an immovable object. Once you've killed the dragon, however, you can't get back to the room in which he's still alive.

Workman's implementation of Adventure includes a "wizard" routine that lets you move freely through the dungeon. He doesn't tell you how to use the routine unless you buy the "Build-an-Adventure Kit."

To build an adventure, you use a standard editor, such as Wordmaster, to alter the game data base (or create a new one), after which you invoke a BUILDER program. The program takes your logically ordered data base and makes a work file out of it, while simultaneously patching other chunks into the ADVENT.COM file that controls the game.

You can construct very complex dungeons and when you're done you have a game that recognizes vocabulary. You don't have to specify the permissible moves the way you must in BASIC adventure games.

I asked Workman how many of the people who buy the game intend to market adventures and he chuckled. He isn't sure, but he suspects that most copies are sold to people who bought Adventure and then couldn't solve the puzzles and mazes. "We give them the original Adventure data base with the Adventure Kit," Workman said. "That contains the Adventure map. We also tell them how to move through the dungeon by magic. I know that's why one guy bought the kit. He kept writing letters begging for the map. When we put out the kit, he bought the first copy."

Coming Up: In the next column I will continue to discuss languages, and I've also collected a raft of data bases I want to talk about. And I just finished letting Zeke do my taxes.... ■

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Hughes, Joan K. *PL/I—Structured Programming*, second edition. New York: John Wiley & Sons, 1979.

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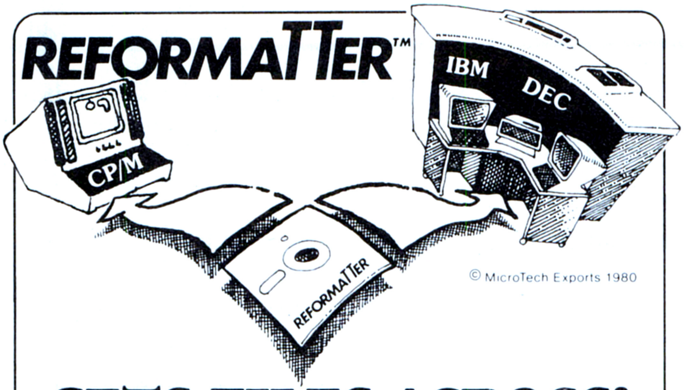

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Book Reviews

Apple Pascal: A Hands-On Approach

Arthur Luehrmann and
Herbert Peckham
McGraw-Hill Book Company, New York, 1981,
432 pages, softcover,
$14.95

Reviewed by
Hartley G Lesser
3243 Oakes Dr
Hayward CA 94542

I knew very little about Pascal when I first sat down with this book. I had read a few magazine articles that described Pascal as a structured and understandable language, but my only programming experience was with BASIC and assembly language. I needed an introduction that assumed no prior knowledge, yet, at the same time, I wanted a book that didn't talk down to me. I'm happy to report that *Apple Pascal: A Hands-On Approach* is not only thorough and clear, but also treats the reader as the authors' equal. Although the authors begin at the most basic level, they seldom sound like lecturers. They teach as if they and the reader are working together on a series of intriguing experiments.

Written in a manner that will hold the interest of adults, this book also explains things clearly enough for children. My nine-year-old son worked through the first three chapters with apparent ease, although at a pace somewhat slower than my own. He learned to write simple Pascal programs and save them on disk, and moved on to the session on the graphics features of the Apple Pascal system. Judging from our experience, *Apple Pascal: A Hands-On Approach* will meet the needs of a wide variety of readers.

Although it focuses on Pascal, the book has more general applications. In addition to describing the mechanics of this one language, it explains sound programming techniques. If you have access to an Apple, then this book is an excellent way for you to learn the art of programming as well as the virtues of Pascal.

Hands On!

The title means what it says: this book's instructional method really requires you to get your hands on an Apple and work your way through. Mastering the material presented will require that you commit several hours each day to sessions with the Apple. The sessions present simple but interesting procedures that produce clear results—whether they be music, graphics, or text.

I resolved to spend two or three hours in front of my Apple each day for about six weeks. Sometimes events disrupted my schedule, but that only pointed out another of the book's strengths: the presentation of information in a natural sequence. With a minimum of rereading, I was usually able to pick up where I had left off. And at the end of six weeks of study, I had a firm grasp of the basics of Pascal.

The book is organized into work sessions rather than conventional chapters. The authors' method is to describe a project in general terms, and then try different approaches to see what works and what doesn't. The reader understands each point thoroughly as a result of running several slightly modified versions of the same program before achieving complete success.

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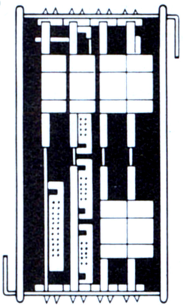

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The authors are careful to demonstrate the traps in the language system and how to cope with them. In fact, they instruct you to commit errors, then explain each error so that you really understand why some programs won't compile and run correctly. The explanations are all the more effective because they come after the demonstration.

Each new session begins with a brief summary of the previous session. After outlining the goals of the new session, the authors break it down into manageable sections. Each section treats a specific feature of Pascal—whether it be the command prompts, the use of variables, or the grammar rules that apply to the procedures under study. The authors end each session by presenting a brief summary and a series of thought-provoking questions and problems.

I strongly recommend that you answer the session-review questions and problems before you go on to the next session. The questions test your comprehension of the material presented, and although some questions are difficult, answering them lays a foundation for work to come. An appendix contains the answers, and the temptation to peek can be strong. Try to refrain from peeking until you've worked out your best answer to each question or problem. Then, of course, you can check your answers against those in the appendix.

Getting Started

Session 1, "Getting Started," tells the reader what he or she needs in order to work with the book: an Apple II or Apple II Plus computer with 48 K bytes of RAM (random-access read/write memory), a properly installed language system, a TV monitor or a TV receiver with RF (radio frequency) modulator, and a pair of game paddles. Only one disk drive is required, but instructions are included for using more than one. The text calls for Apple Pascal version 1.1, contained on two disks marked Apple0: and Apple3:. Both disks come with the purchase of the language system. The authors provide an appendix, however, for users of Apple Pascal version 1.0 that states every change that must be made in the text to accommodate the earlier version of the language. They stress the importance of keeping back-up copies and explain all of the 26 steps necessary to copy the distribution disks using two drives (Appendix B) and the even more numerous steps necessary when using a single drive (Appendix A).

Session 1 proceeds with instructions for "booting" Pascal and then guides the reader on a tour of the Pascal system that includes the command-prompt line, the file-prompt line, the filer's date-set command, the filer's "volume" feature (which displays a list of input and output devices that are "on-line"), and the filer's L command (which lists the directory of a disk). The session ends with an explanation of how to toggle from one half of the Pascal "page" to the other. Considering how much material the first session covered, I was surprised at how smoothly everything had gone.

The Pascal editor, including how to obtain the workspace needed to create programs and how to move programs into and out of memory and onto a disk, is explained in Session 2. Session 3 teaches the writing, running, and changing of programs. It was during this session that I first began to feel at ease with the Pascal language. In fact, the language seemed hospitable to my input.

Session 4 demonstrates the use of built-in procedures and taught me how to generate sound. I also learned how a function could provide input to a program, how a For loop works, and how to rename a disk or a file.

In Session 5, the importance of the distinction between local and global variables is emphasized, and the creation and calling of new procedures is explained.

Session 6 explains functions, comments brackets, and some new features of the editor. Session 7 presents more about graphics. I learned to use the "turtle," the creature that crawls across the screen drawing lines with pens of different colors—but I did encounter some difficulties in the process. I rushed through this session the first time. On the second time through, I was able to complete answers to all the questions and to write the programs requested by the authors. As a result of this experience, I recommend that you study at a moderate pace.

Session 8 covers branching statements, more graphics features, and the technique of obtaining user input for a running program. Session 9 tackles string variables and While loops, and Session 10 teaches number types and arithmetic. The authors deserve particular praise for this chapter; I loathe mathematics but found the material both interesting and effortless to learn.

Discovering the Scalars

Session 11 introduces scalar data types and sets. This session is strikingly successful in leading the reader to discover, by directed experiments, what a scalar data

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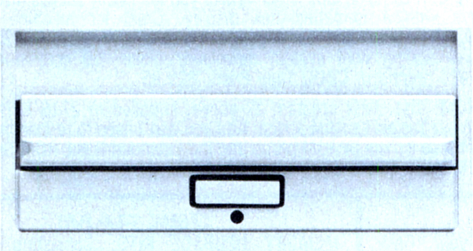

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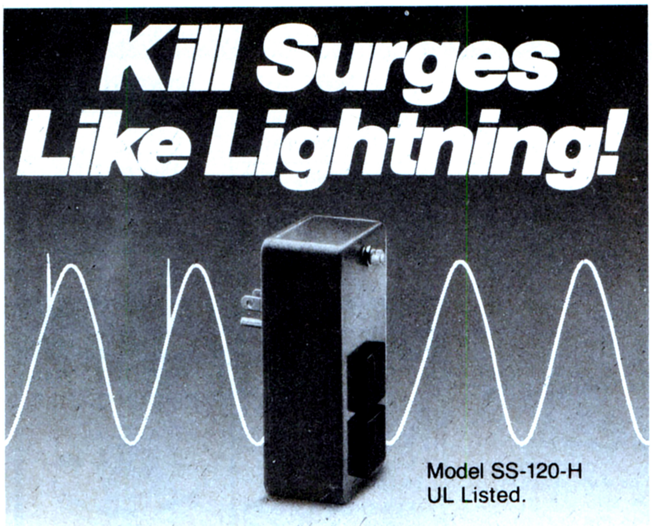

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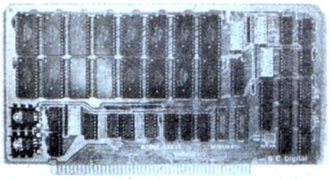
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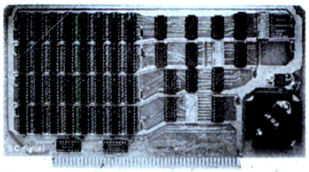
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type is. A few quotes (page 238) will give you an idea of the writing style:

> What is WHITE anyway? Well, what things could it be? First we note that WHITE appears in this program as a *parameter* that is being passed to the PENCOLOR procedure. That rules out the possibility of its being a reserved word, such as IF or FOR or WHILE or BEGIN, since reserved words never have *values*.
>
> The things that have values in Pascal are *variables*, *constants*, and *functions*. Perhaps WHITE is one of these things. . . . if WHITE is an integer or a real number or a character or a string, then WRITELN (WHITE) will tell us what its value is.
>
> Insert a semicolon after READLN and then the following new line:
>
> WRITELN (WHITE)
>
> Run the new version.
>
> Well, whatever WHITE is, it does not belong to one of these standard data types. The error message makes that plain. WHITE seems to have a value, but it is not a number, a character, or a string. Very mysterious.
>
> Here's another approach. . . .

And so on. The reader sees scalar data types and what they will and won't do. The authors let the reader infer much about scalars, and let the reader enjoy a real sense of discovery at every stage. The scalar data types are defined only after they have been revealed; by then, the reader feels like the Amerigo Vespucci of the scalars.

Session 12 uses the same experimental approach to introduce arrays and their uses. Session 13 provides a thorough introduction to records and file systems. Session 14, the last in the book, discusses recursion and its uses. The session ends with a dazzling color-graphics program.

In addition to the appendices already mentioned, there are the following: "Names, Reserved Words, and Built-in Names," "The Command Structure of Apple Pascal," "Size and Quantity Limits in Apple Pascal," and "ORD and CHR Values of ASCII Character Set." A list of the 500 compiler error messages follows a comprehensive index.

Every book has its flaws, but those I will name are minor. There are some instructional paragraphs that are long and tedious—more, I think, as a result of the book's design than of the authors' prose. A more liberal use of graphics would have broken the paragraphs into digestible chunks. The book also neglected two important commands: the one that clears the screen of text and the one that inserts tabs in output to the screen. I found these commands elsewhere, but the book should have mentioned them.

In summary, *Apple Pascal: A Hands-On Approach* is a fine introduction to a powerful and increasingly popular programming language. I can unhesitatingly recommend this book to any Apple owner, and I would jump at the chance to buy a sequel.■

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Book Reviews

Threaded Interpretive Languages

by R G Loeliger
BYTE Books,
Peterborough NH
1981, 251 pages,
hardcover, $18.95

Reviewed by
A Richard Miller
61 Lake Shore Road
Natick MA 01760

Ron Loeliger's new book may well be the most important one in years for a growing number of FORTH programmers and enthusiasts. Although the book is called *Threaded Interpretive Languages*, the prospective reader should know that its subject is FORTH.

This book is well written and witty, but be warned that it is not trivial. It sets out to implement a Z80-based computer language, right before your eyes. The author calls his language ZIP: again, read FORTH.

For those who are able to discriminate among versions of this "newly arrived," high-level language (and/or assembler, and/or interpreter, and/or compiler, and/or operating system, and/or total computer environment, and/or seemingly whatever you wish), ZIP is a close approximation of microFORTH from FORTH, Inc. It is also generally similar to fig-FORTH, and to FORTH-79 systems including MMS-FORTH

It has become traditional to introduce FORTH with a series of initially baffling keyboard entries. One might lead off with some arithmetic, using FORTH's Reverse Polish Notation (eg: the FORTH phrase { 5 5 * . }) instead of BASIC's more familiar ("PRINT 5*5. Next, one might demonstrate FORTH's ability to add new words to its instruction set, adding a new word to do a given job (eg: the FORTH phrase { : SQUARE DUP * . ; } compiles a new instruction named SQUARE, which then might be executed as { 5 SQUARE } to do the same thing as the above examples). Soon, one is switching number bases with HEX, and DECIMAL, switching dictionary vocabularies with EDITOR , ASSEMBLER and FORTH , and eventually creating whole new types of defining words with <BUILDS (79-STANDARD now calls it CREATE) and DOES> .

This traditional approach presumes that one must have many hours of low-level experience with the language before considering why FORTH works the way it does. As with BASIC, most users never get around to learning how FORTH literally threads its way through the internals of the computer to gain its ends. But its unique internal design makes FORTH what it is and *Threaded Interpretive Languages* starts with internal design and stays there for most of its pages. It assumes no knowledge of FORTH but does demand more than a beginner's familiarity with computers. To practice routine FORTH operations, get another book, a lot of sample FORTH source code, an adequate FORTH system to run on your computer, and some learning projects of your own. To learn FORTH inside out, however, buy this book!

Any good FORTH system is very compact and very fast. For example, on the TRS-80 Model I or III, MMS-FORTH is about 20 times faster than Level II BASIC. Thus, many programmers do all FORTH programming in high-level FORTH. But FORTH includes a resident assembler and, where extra speed helps, it is at your command. I like the author's unbiased way of balancing the trade-off between the ease and elegance of high-level FORTH and the "brute force" capabilities of assembly language.

The publisher deserves praise for treating this book as just that—a book. Up to now, most FORTH books have been indifferently printed and looseleaf bound. In contrast, *Threaded Interpretive Languages* is a solid little hardcover book, professionally produced and with a touch of class.

I do have some minor criticisms. The book uses black squares to represent the space characters within the code. Although it is useful to indicate the spaces (rather than to assume them), these large black squares overwhelm the eye and distract the mind. I recommend the use of unobtrusive open squares for the book's next edition. In a similar vein, the input lines are printed with proportional spacing between the characters, in contrast to the "typewriter-spaced" uniformity of a video terminal. Although this "typeset" style may appear more attractive, it is less faithful to the original material and is, I believe, misapplied here.

It is unfortunate that the author chose to call the language ZIP instead of FORTH, as that further complicates the issue. I imagine that, when he wrote this material, he wished to avoid any conflict with FORTH, Inc, which holds the rights to its name. However, in the last few years, FORTH, Inc has been gracious enough to encourage systems houses to produce versions with several variants on the name. His caution, therefore, appears unnecessary and—given the title of this important book—somewhat misleading.

It may also be misleading to say that the book implements a computer language. It does, but the author correctly warns that the implementation will require some work by the reader. It will also require some decisions that will affect certain trade-offs, lots of ability, time, patience, and a very good idea of what you intend to accomplish. A few expert programmers will follow his pattern to create elegant and streamlined FORTH. Others may concoct unfortunate approximations of good systems.

Most readers will do neither, but reading this development of a FORTH system will enable them to appreciate the several complete FORTH systems now available for microcomputers.

As a good book on music theory stimulates musicians, I believe this text will serve most effectively as a marvelous insight for those working with existing—and debugged—FORTH systems. In other words, do not study music theory without practicing on a musical instrument. And, if at all possible, do not design an instrument without first playing on another.

FORTH has existed only for a decade. It has thousands of users, but it was invisible to the general microcomputer community until the special FORTH issue of BYTE (August 1980). In this reviewer's opinion, *Threaded Interpretive Languages* is the first book of excellent quality among the few written about the language. ■

Software Received

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

Apple

Auto-Modem, a telecommunication utility program for the Apple II. Floppy disk, $39.95. Computer Station, 11610 Page Service Dr, St Louis MO 63141.

Castle Wolfenstein, a real-time graphics adventure program for the Apple II and Apple II Plus. Floppy disk, $29.95. Muse Software, 330 N Charles St, Baltimore MD 21201.

Enhanced Centronics 739 Graphics Software, a utility program that prints high-resolution graphics for the Apple II. Floppy disk, $44.95. Computer Station (see address above).

Enhanced Graphics Software, for the Epson MX-80. A utility program that prints high-resolution graphics for the Apple II. Floppy disk, $44.95. Computer Station (see address above).

Enhanced Graphics Software, for the NEC Spinwriter (5510/5520). A utility program that prints high-resolution graphics for the Apple II. Floppy disk, $44.95. Computer Station (see address above).

Falcons, a graphics arcade game for the Apple II and III. Floppy disk, $29.95. Piccadilly Software Inc, 89 Summit Ave, Summit NJ 07901.

MACRO-SCED 2.1, a cursor-oriented screen editor for the Apple II. Floppy disk, $49.95. Computer Station (see address above).

Micro-DSS/Finance, a financial planning and analysis package for the Apple II Plus. Floppy disk, $1500. Addison-Wesley Publishing, Jacob Way, Reading MA 01867.

NET-WORKS, a bulletin-board and information-service system for the Apple II. Floppy disk, $124.95. Computer Station (see address above).

P-LISP 2.0, an implementation of the interpretive language LISP for the Apple II. Floppy disk, $99.95. Pegasys Systems Inc, 4005 Chestnut St, Philadelphia PA 19104.

Powertext, a word-processing program for the Apple II. Floppy disk, $199. Beaman Porter Inc, Pleasant Ridge Rd, Harrison NY 10528.

Professional Easywriter Version 4, a word-processing program for the Apple II. Floppy disk, $250. Information Unlimited Software, 281 Arlington Ave, Berkeley CA 94707.

Ultra Hi-Res Graphics, a utility program that plots as much as a full page of output for the Paper Tiger 460G to 560G series printers and the Apple II. Floppy disk, $49.95. Computer Station (see address above).

Word Handler, a word processor that does not require hardware modifications for the Apple II. Floppy disk, $189. Silicon Valley Software, 652 Bair Island Rd, Redwood CA 94065.

Zork: The Great Underground Empire, Part I, Adventure-type game for the Apple II. Floppy disk, $39.95. Personal Software, 1330 Bordeaux Dr, Sunnyvale CA 94086.

Commodore VIC

Biorhythm Compatibility, a program that compares biorhythm charts for the Commodore VIC-20. Cassette, $14.95. Commodore, 950 Rittenhouse Rd, Norristown PA 19403.

Space Math, a utility program that solves basic mathematical problems for the Commodore VIC-20. Cassette, $14.95. Commodore (see address above).

TI 99/4

Invoice Management, a utility program that maintains a customer-invoice file for the TI-99/4. Floppy disk, $69.95. Texas Instruments Inc, Dallas TX 75265.

Saturday Night Bingo, a board game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc (see address above).

Speak & Spell Program, emulates a TI Speak & Spell for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc (see address above).

Structural Engineering Library, five programs that solve engineering problems for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc (see address above).

Teach Yourself Extended BASIC, a self-help guide to TI Extended BASIC for the TI-99/4. Floppy disk, $24.95. Texas Instruments Inc (see address above).

TRS-80

B17 Disk/Bas, a utility program that saves and loads disk files to and from cassette tapes for the TRS-80 Model I. Cassette, $14.95. ABS Suppliers, POB 8297, Ann Arbor MI 48107.

CC Writer, a word-processing program for the TRS-80 Color Computer. Cassette, $30. Transformation Technologies, 194 Lockwood Ln, Bloomingdale IL 60108.

DC Circuit Analysis, a program that solves DC circuits for the TRS-80 Model I. Cassette, $11.95. Computer Heroes, 1961 Dunn Rd, East Liverpool OH 43920.

KWIK Cassette Operating System, for the TRS-80 Model I. Cassette, $24. KWIK Software, POB 328, Bolivar MO 65613.

Maxi Manager A.3, a database management system for the TRS-80 Model I. Floppy disk, $99.95. Adventure International, POB 3435, Longwood FL 32750.

New DOS/80 Version 2.0, a disk operating system for the TRS-80 Model I. Floppy disk, $149. Apparat Inc, 4401 S Tamarac Parkway, Denver CO 80237.

Stock Scoreboard, computes investment return and updates holdings for the TRS-80 Model I and III. Cassette, $15. Gary L Gilbert, 975 D Elgin, San Lorenzo CA 94580.

Wordsmith, a word processor for disk systems, for the TRS-80 Model I. Cassette, $14.95. ABS Suppliers (see address above).■

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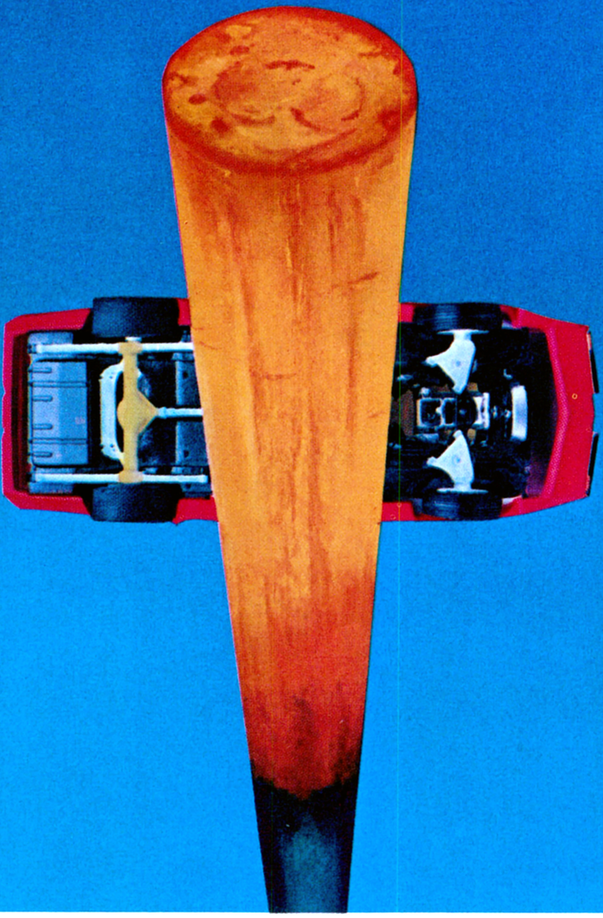

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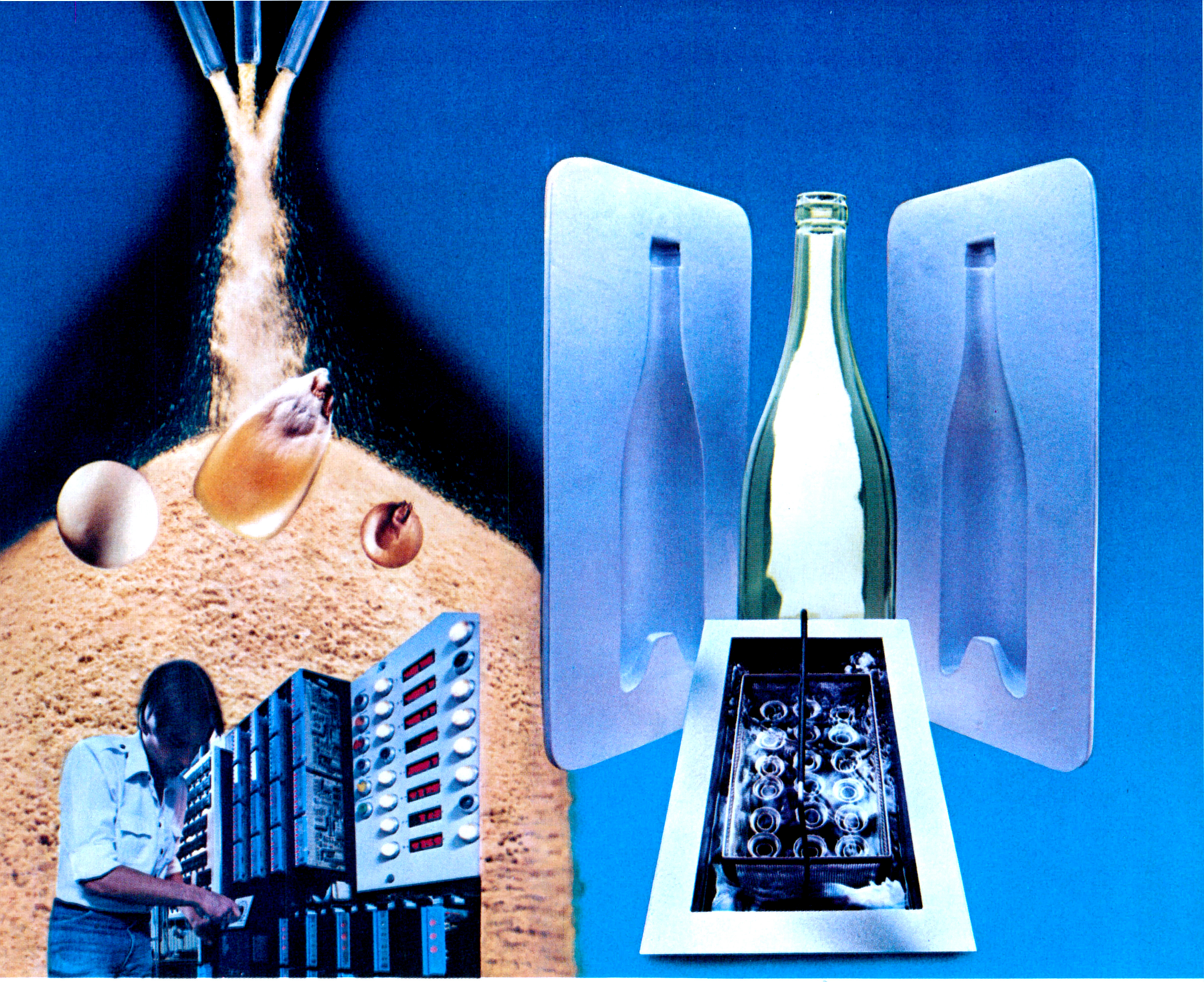

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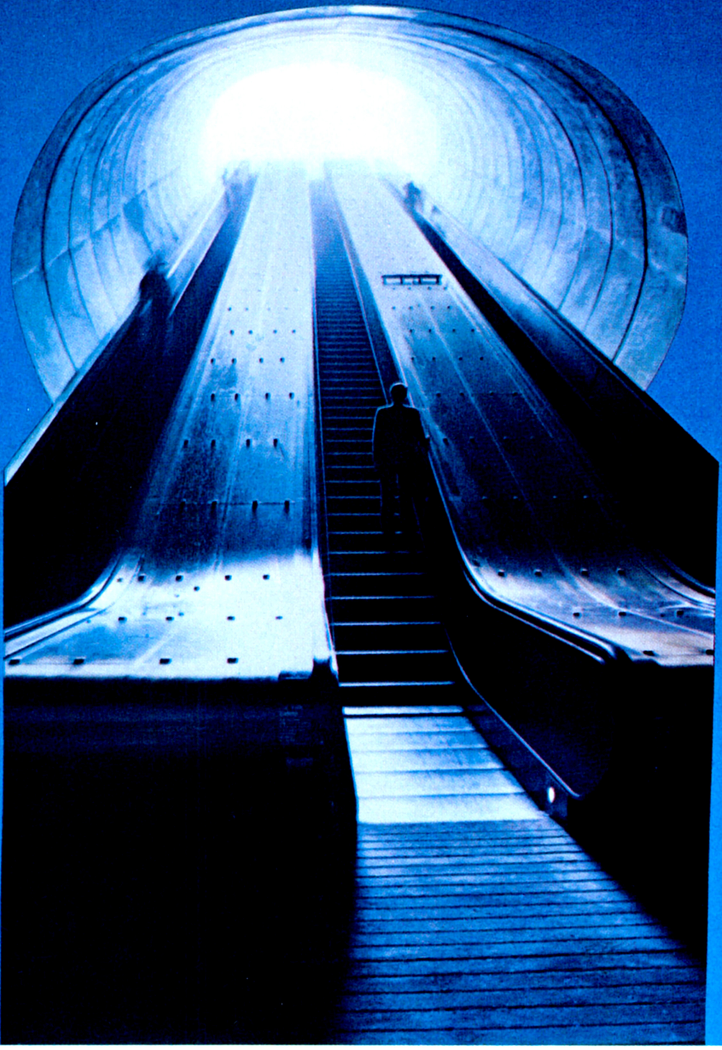

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Modular escalators will save over $150,000 per year in energy costs for the mass transit system of a major East Coast city.

The 354 Westinghouse Moduline 100® escalators used there save 30 percent of energy costs when going "up," 60 percent when going "down" compared to the conventional type.

These advanced Westinghouse escalators can be connected in modular sections, giving architects a design freedom they never had before. These escalators can skip a floor, span vertical rises of 100 feet or more, and provide a nonstop 10-story ride.

That's right, 10 stories.

Westinghouse technology for the future.

Electricity from sunlight is one step closer to economic reality.

The unique Westinghouse Dendritic Web process promises to significantly reduce the cost of manufacturing photovoltaic cells.

It produces long, thin, continuous strips of single crystal silicon, the main component of solar cells. The costly and wasteful slicing of silicon blocks has been eliminated.

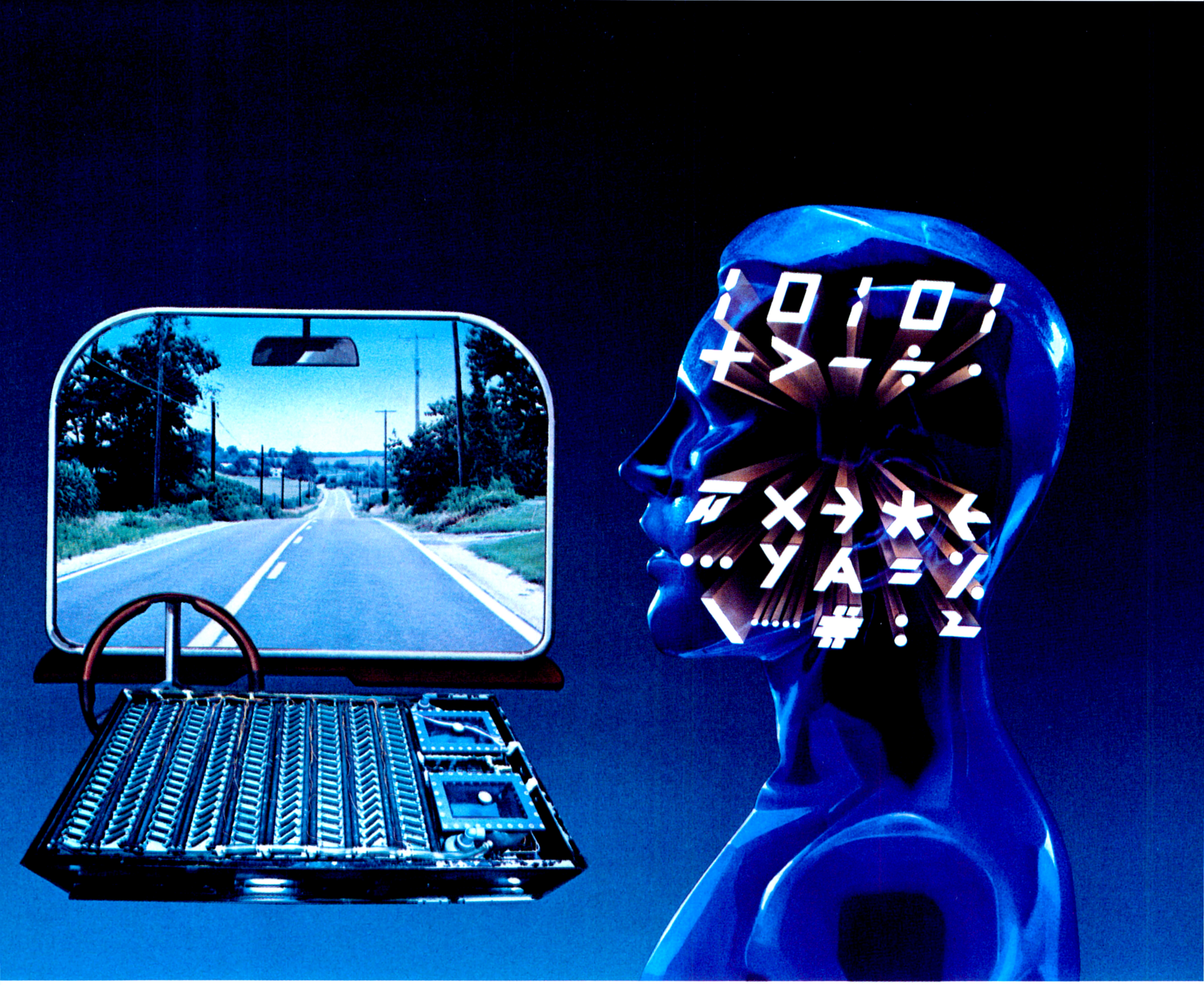
Modules like the one pictured behind the dendritic strip above can produce up to 16 watts per square foot. Now, Westinghouse is working toward automated production facilities. And we've designed and installed systems for residential application.

Fuel Cells promise to be a highly efficient, compact, nonpolluting source of electric power.

Westinghouse is developing two types of fuel cells.

One is a phosphoric acid fuel cell targeted for the mid 80's. It converts any hydrogen-rich fuel such as synthetic gas from coal directly into electricity. It's environmentally benign, the only by-products are carbon dioxide, heat and pure water.

The other type is a solid oxide design. It's even more compact and more fuel efficient than the phosphoric acid fuel cell. With an 1800°F operating temperature, it's ideal for industrial cogeneration. It should be ready for use by the mid 90's.



High Power Battery technology may soon give commercial vehicles such as delivery vans a 100-mile cruising range, take only 4 to 6 hours to recharge, and last 100,000 miles.

Westinghouse is developing a high power nickel-iron battery that offers the best combination of high energy density, long life cycle, longer time between charges and competitive life cycle costs.

Smaller and lighter than older types of batteries, the new Westinghouse nickel-iron battery could also replace fossil fuels as the power source for industrial forklifts, mining machines, and airplane tow trucks.

It's already in limited production.

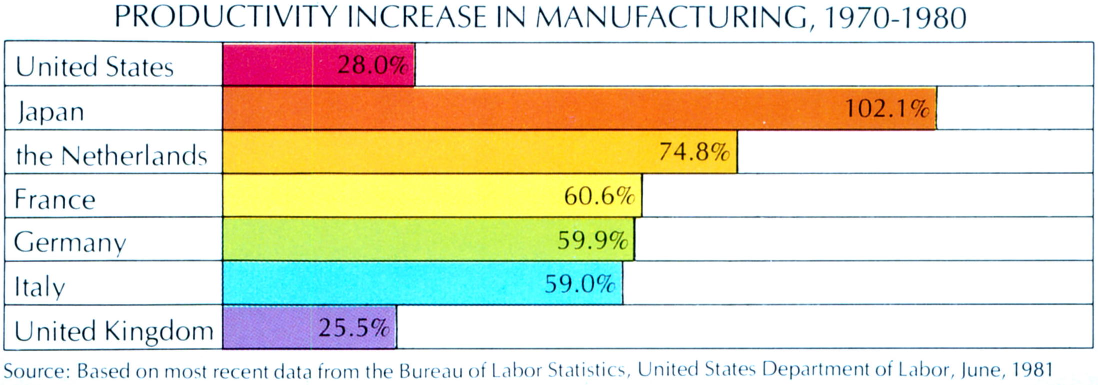
Super Small, Super Fast Processors will dramatically enhance America's military capabilities and ultimately revolutionize American industry.

Very High Speed Integrated Circuits (VHSIC) will increase processing capabilities by over 1,000 percent. It will be possible to put up to 500,000 transistors on a single chip.

The production and use of very pure silicon will enable such chips to process information at much higher rates of speed. And they'll require 1,000 times less power.

And advanced circuit pattern printing techniques will help deliver all of this capability in a package 400 times smaller than today's!

Through its technology, Westinghouse is ready to help American industry increase productivity



Source: Based on most recent data from the Bureau of Labor Statistics, United States Department of Labor, June, 1981

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Computer Club Rides in Central Texas

The Computer Club of San Marcos has been formed to promote personal computing in central Texas. Correspondence from other clubs is invited, and all can attend meetings. For information, contact January Smith, POB 381, Martindale TX 78655, (512) 357-6762.

Packet-Switching Network

VADCG (Vancouver Amateur Digital Communications Group) is devoted to creating a packet-switching network via amateur radio. It is experimenting with high-speed protocol transmissions, and efforts are underway to connect a smart terminal node-controller board that interfaces any parallel or asynchronous serial device to the network. Other projects include an S-100 card to provide the centralized station node network control and a 1200-bit-per-second modem for connection to VHF (very-high frequency) transceivers. Some public-domain software is available and more is being developed. Newsletter subscriptons are $10 from VADCG, 818 Rondeau St, Coquitlam, British Columbia, V3J 5Z3, Canada.

Computer Graphics Software News

The Computer Graphics Software News reviews computer programs in the public and industrial domain that deal with computer-generated graphics. Areas of interest are computer-aided design and manufacturing, animation, business graphics, image processing, and petrophysical-related software. The subscription rate is $50 a year (six issues). Contact *The Computer Graphics Software News*, 5857 S Gessner, Suite 401, Houston TX 77036, (713) 975-8509.

PET Users Meet in Golden State

The Southern California PET Users Group meets the first Tuesday of each month at 7 PM at the Data Equipment Supply Corporation, 8315 Firestone Blvd, Downey, California. For more details, call Lyle Phillips at (213) 693-3175.

CCAN

Construction Computer Applications Newsletter-CCAN is a monthly publication from the Construction Industry Press. It has information and reviews on computer products designed exclusively for the construction industry. A one-year subscription to the *Construction Computer Applications Newsletter–CCAN* costs $48. Contact the Construction Industry Press, 1105-F Spring St, Silver Spring MD 20910, (301) 589-4884.

Mail-Order Software Library

ESL (Educational Software Library) is a nonprofit, mail-order library of educational programs for the TRS-80 Models I and III. Members receive a bimonthly newsletter that describes current selections, which range from preschool to high school level.

A one-year membership costs $20 and entitles you to the newsletter, two educational tapes, the opportunity to borrow programs for two-week periods at $2 per tape, and the chance to purchase software at discount prices. Contact ESL Inc, 262 Park Ln, King of Prussia PA 19406.

Microsrv Newsletter

The *Microsrv* newsletter has short articles, technical tips, news, and programming help. It is primarily for Apple users, but much of the information can be applied to any system. For details on subscriptions or submitting editorial material, contact *Microsrv*, 20th Century Business Systems, 324 W 145th Pl, Riverdale IL 60627, (312) 841-3400.

Librarians and Microcomputers

The University of Arizona Graduate Library School has announced the availability of the *Small Computers in Libraries Newsletter*. The newsletter acts as a clearinghouse for the sharing of information on microcomputers in libraries. It offers glossaries, short tutorials, and reviews of programs and books pertinent to the subject. Subscriptions start at $20 from the Graduate Library School, Attn: SCIL, University of Arizona, 1515 E First St, Tucson AZ 85719, (602) 626-3565.

New TRS-80 Group in North Carolina

The Greensboro TRS-80 Group is a recently formed club that wants to learn all it can about TRS-80 equipment. Contact David K Bodman, POB 7785, Greensboro NC 27407, (919) 855-9155.

Sun Shines On New CBBS

A new CBBS (computerized bulletin-board system) has gone on line in Orlando, Florida. The system is positioned to service central Florida, and licenses are available for other areas. No particular subject dominates the board. The 24-hour telephone number is (305) 830-8166.

National Apple Newsletter

Owners and users of Apple II and II Plus computers now have a club publication devoted to their needs. *The National Apple Newsletter* will print anything members demand: Pascal programs, home control, computerized alarm systems, and other practical applications. For more information, contact Scott Summer, 27 Leicester Way, Pawtucket RI 02860.■

Event Queue

November 1981

November-December

Courses from Datapro, various sites throughout the US. Datapro Inc's educational program features seminars and one-day management briefings on a wide range of subjects. Among the topics to be presented are "Structured Systems Analysis," "Introduction to Micro/Personal Computers," "Local Networks," "Evaluating and Selecting Computer Software Packages," and "BASIC: Introduction to Computer Programming."

Seminar enrollment fees are $595 for Datapro subscribers and $645 for nonsubscribers. The management briefings cost $360 and $395, respectively. Contact Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (800) 257-9406; in New Jersey (609) 764-0100.

November-December

The Master Method of Selling Small Business Systems, various sites throughout the US. MWL Inc is offering a series of one-day seminars for manufacturers of small-business systems and software vendors. The price for a seminar is $135. Contact the Seminar Coordinator, MWL Inc, 32038 Watergate Ct, Westlake Village CA 91361, (213) 889-2607.

November-March 1982

Two-Day Seminars for Professional Development, Worcester Polytechnic Institute, Worcester MA. Courses on the fundamentals of data processing, data communications, and microprocessors are being offered by Worcester Polytechnic Institute at its campus and at selected locations in the Boston metropolitan area. The fee is $445. Contact Ms Ginny Bazarian, c/o the Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609, (617) 793-5517.

November 12-14

Accounting and Information Systems Expo '81, MGM Grand Hotel, Reno NV. This exposition is geared toward accounting experts and information-systems analysts, designers, and managers. The emphasis will be on technological advances in the field and ways in which these advances can improve efficiency and effectiveness. For more information, contact Leanne Stone, c/o the University of Nevada-Reno, Division of Continuing Education, College Inn, Reno NV 89557, (702) 784-4046.

November 13

The Impact of New Technologies on Information Service Environments, Battelle Columbus Laboratories, Columbus OH. The Ohio chapters of ASIS (American Society

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Archives Model III	6,269.00
CCS Series 300-1A	4,414.00
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Cromemco System 3	5,650.00
Cromemco Z-2H	7,521.00
Dynabyte 5200-A2	3,216.00
Dynabyte 5200-B2	4,896.00
Dynabyte 5615-A1	8,396.00
Ithaca C.B. 128KSS/OD	5,421.00
Ithaca Sys. 2A W/Panel	2,941.00
NEC 8001A	1,014.00
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NEC 8031A	1,014.00
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North Star Adv.	$2,995.00
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Televideo System II	5,311.00
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Qume Sprint 9-45	1,996.00
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DEC VT 100	$1,495.00
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for Information Science) are sponsoring this one-day seminar. Speakers and a panel will examine the impact of electronic publishing, videodiscs, and personal computers on libraries and corporate information centers. Registration fees are $40 for ASIS members, $50 for nonmembers, and $10 for students. For details, contact Katherine Frohmberg, Oberlin College Library, Oberlin OH 44074, (216) 775-8285.

November 13-15

The Los Angeles Computer Showcase Expo, Convention Center, Los Angeles CA. The Computer Showcase is designed to place vendors and their intermediaries in touch with small-computer-system users. For details, contact the Interface Group, 160 Speen St, Framingham MA 01701, (800) 225-4620; in Massachusetts (617) 879-4502.

November 16-17

Computer-Aided Graphics Systems: Design and Drafting Tools, Marriott Pavilion Hotel, St Louis MO. This course has been designed for middle- and upper-level administrators who are responsible for planning, evaluating, selecting, acquiring, and implementing computer-graphics systems for industrial design and drafting purposes. The course fee is $295.

For technical information, contact Ralph E Lee, Mathematics-Computer Science Building, University of Missouri-Rolla, Rolla MO 65401, (314) 341-4491. Course or registration information can be obtained from Martha K Fort, Arts & Sciences Continuing Education, 105A Humanities-Social Sciences Building, University of Missouri-Rolla, (314) 341-4943.

November 16-19

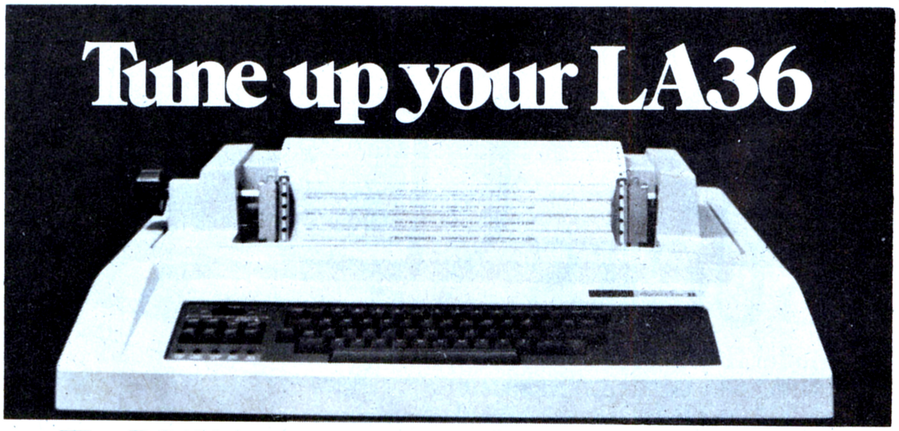
The 1981 Electronics and Aerospace Systems Conference (EASCON '81), Washington Hilton Hotel, Washington DC. The theme of this conference is "Government-Industry Interchange." The exhibition will include displays from many electronics and aerospace companies. For details, contact EASCON '81, 608 H St, SW, Washington DC 20024, (202) 347-7088.

November 19-21

Business and Personal Computer Sales-Expo '81, Philadelphia Civic Center, Philadelphia PA. The Sales-Expo is aimed at a wide range of computer users. The show features exhibits of microcomputers, business supplies, peripherals, and software. For more information, contact Produx 2000 Inc, POB 2000, Bala Cynwyd PA 19004, (215) 457-2300.

November 20-22

Symposium on Small Computers in the Arts, Philadelphia PA. The Symposium on Small Computers in the Arts (formerly the Personal Computer Arts Festival) is being held to bring together individuals interested in using small computers in the audio and visual arts. The Symposium will offer a range of presentations from introductory tutorials to sessions on advanced techniques. Workshops, exhibits, and demonstrations are also planned.



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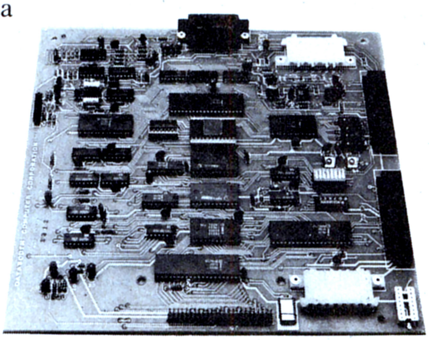

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See Us At COMDEX'81 November 19-22, 1981 Las Vegas Convention Center, Las Vegas, NV

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Complementing the Symposium will be the Fourth Annual Computer Music Concert. Contact the Symposium at POB 1954, Philadelphia PA 19105, (215) 243-8109.

November 22-24

Data-Telecommunications Expo, Rhein-Main-Halle, Wiesbaden, West Germany. Exhibits of equipment and systems for applications in commerce and industry plus a conference program complementing these subjects will be presented. Details are available from Kiver Communications S.A., UK Branch Office, 171/185 Ewell Rd, Surbiton, Surrey, KT6 6AX, England.

December 1981

December 1-3

Legal Info, Shoreham Hotel, Washington DC. Automating legal-information systems is the subject of this conference and exposition. Attorneys wishing to use computers in their work are invited to attend. Contact Legal Info, 1730 N Lynn St, Suite 400, Arlington VA 22209, (703) 521-6209.

December 1-4

Computer-Network Design and Protocols, Washington DC. Integrated Computer Systems (ICS) will be presenting a course on fundamentals in computer communication-network concepts, technology, and implementation. Emphasis is on the practical aspects of network design, interfacing, protocols, and packet switching. For a schedule of times and locations, contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd, POB 5339, Santa Monica CA 90405, (800) 421-8166; in California (800) 352-8251.

December 2-3

Introductory Seminar on UNIX, Key Bridge Marriott Hotel, Arlington VA. Human Computing Resources Corporation is offering this two-day seminar on the use of UNIX for programmers, analysts, and anyone needing to know about this operating system. For details, contact the Course Coordinator, c/o Human Computing Resources, 10 St Mary St, Toronto, Ontario, M4Y 1P9, Canada, (416) 922-1937.

December 3

California Computer Show, Hyatt Hotel, Palo Alto CA. For details and a schedule of upcoming events, contact the Show Administrator, c/o Norm De Nardi Enterprises, 95 Main St, Los Altos CA 94022, (415) 941-8440.

December 3-4

Computer Graphics: Microprocessor/Personal Computer Systems, Marriott Pavilion Hotel, St Louis MO. This course has been designed for managers, educators, and graphics users responsible for evaluating and acquiring microcomputers and graphics systems. The course fee is $195.

For technical information, contact Ralph Lee, Mathematics–Computer Science Building, University of Missouri-Rolla, Rolla MO 65401, (314) 341-4491. Course or registration information can be obtained from Martha K Fort,

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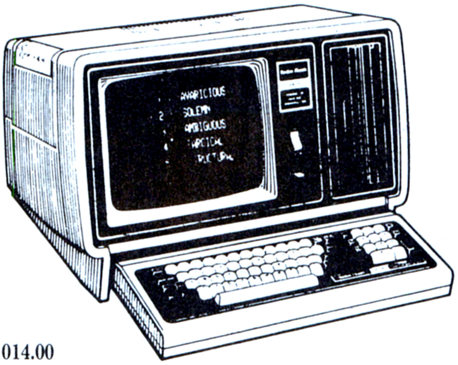

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26-3001 4K	$353.00
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Arts & Sciences Continuing Education, 105A Humanities–Social Science Building, University of Missouri–Rolla, (314) 341-4943.

December 8

Computer Networking Symposium/National Bureau of Standards, Gaithersburg MD. This conference is being sponsored by National Bureau of Standards and the Institute of Electrical and Electronics Engineers. Contact Robert Toense, B226 Technology Building, National Bureau of Standards, Washington DC 20234, (301) 921-3516.

December 9-11

The 1981 Winter Simulation Conference (WSC 81), Peachtree Plaza, Atlanta GA. WSC 81 will feature papers, panel discussions, and tutorials on discrete and combined simulation and modeling. The conference will be organized into tutorial, methodology, and application sessions. For information, contact John Carson, WSC 81 Registration Chairman, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta GA 30332, (404) 894-2308.

December 15-19

Gulf Computer Exhibition, Dubai International Trade Centre, Dubai, United Arab Emirates. IBM, NCR, Apple, Honeywell, Philips, Wang, Hewlett-Packard, Data General, and other well-known manufacturers will be represented at this first exhibition of computer equipment in Dubai. The scope of the show takes in systems ranging from microcomputers to mainframes. Details are available from the Trade Centre Management Company, POB 9292, Dubai, United Arab Emirates, Telex 47474 DITC EM, and from Diana Clifton Sewell, International Office, Seymour House, 17 Waterloo Pl, London, SE1Y 4AR, England.

December 16-18

The Twentieth IEEE Conference on Decision and Control (CDC), Vacation Village Hotel, San Diego CA. The CDC is the annual meeting of the IEEE (Institute of Electrical and Electronics Engineers) Control Systems Society. It is held in cooperation with the Society for Industrial and Applied Mathematics. The conference will include contributed and invited sessions plus tutorials and presentations on all aspects of the theory and applications of systems involving decision, control, and adaptation. Other topics of interest include linear and nonlinear system theory, stability theory, large-scale system theory and decentralized control, estimation, identification, signal processing and stochastic control, and control systems. For more information, contact the Institute of Electrical and Electronics Engineers Inc, 445 Hoes Ln, Piscataway NJ 08854.

December 28-30

Computer Modeling of Linguistic Theory, Grand Hyatt Hotel, New York NY. The ACL (Association for Computational Linguistics) is sponsoring three sessions on computer modeling of linguistic theory in conjunction with the annual meeting of the Linguistic Society of America. New models for grammars and new strategies

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In previous issues, we listed more than 50 reasons why PMMI MM-103 modems are superior, along with a list of satisfied users that is now too long to print. Quality, integrity and low cost have made the MM-103 America's most popular modem. PMMI was the first to gain FCC approval and meet IEEE-696 S-100 standards. You won't find another modem for the S-100 bus with a wider range of Baud rates, more extensive and controllable software and such an unbeatable warranty. And since PMMI has eliminated the need for an acoustic coupler or an RS 232 adapter, your connection is more reliable and you buy no unnecessary hardware.

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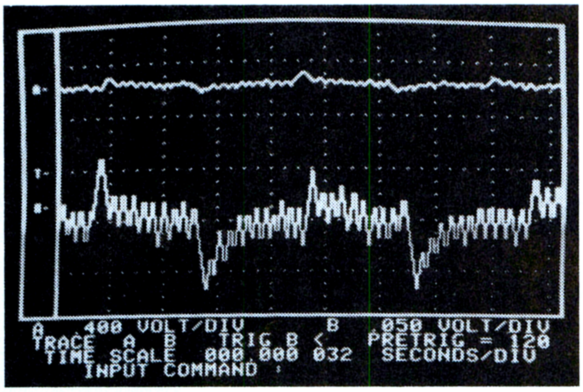

```
A    400 VOLT/DIV      B   .050 VOLT/DIV
TRACE  A  B    TRIG B <   PRETRIG = 120
TIME SCALE   000.000 032   SECONDS/DIV
INPUT COMMAND :
```

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for parsing will be the areas of most attention. Readings of contributed papers will also be featured. Contact Stan Petrick, IBM Research Center, POB 218, Yorktown Heights NY 10598.

January 1982

January-April
Fundamentals of Data Processing for Administrative Assistants and Office Support Staff, various sites throughout the US. The American Management Association (AMA) has designed this three-day course for secretaries, assistants, supervisors, and other personnel desiring to learn the fundamentals of data processing and its use in offices. Computer hardware and software, programming languages, and technology will be covered. The team fee for AMA members is $470 per individual and $550 for nonmembers. Individual fees are $550 and $630, respectively. For a schedule of dates and locations, contact the AMA, 135 W 50th St, New York NY 10020, (212) 586-8100.

January 6-8
The Fifteenth Annual Hawaii International Conference on Systems Sciences (HICSS-15), Honolulu HI. This conference is cosponsored by the University of Hawaii and the University of Southwestern Louisiana in cooperation with the Association for Computing Machinery (ACM). HICSS-15 is intended for medical information-processing researchers and practitioners. Among the topics to be covered are diagnosis by computer, computer-based medical instrumentation, computers and the handicapped, and the use of computers in individual and group practices, medical laboratories, and hospitals. Contact Dr Bruce D Shriver

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and Dr Terry M Walker, c/o HICSS-15 Medical Information Processing, University of Southwestern Louisiana, POB 44330, Lafayette LA 70504.

January 7-10

The 1982 Winter Consumer Electronics Show (CES), Las Vegas Convention Center, Hilton Hotel, and the Jockey Club, Las Vegas NV. Conferences, workshops, seminars, sales meetings, press events, and exhibits of audio and video equipment, computers, telephones, and other consumer items highlight this show. For details, contact Consumer Electronic Shows, Two Illinois Center, Suite 1607, 233 N Michigan, Chicago IL 60601, (312) 861-1040.

January 12-15

Communication Networks Conference and Exposition, Georgia World Congress Center, Atlanta GA. The Communication Networks Conference is designed to bring users and the telecommunications industry together. The Conference features sessions, panel discussions, and tutorials on voice, data, and electronic-mail communications. For information, contact Communication Networks, 375 Cochituate Rd, POB 880, Framingham MA 01701, (617) 879-0700.

January 15-16

Microcomputers in Education, Uses for the 80s, Arizona State University, Tempe AZ. The Tenth Annual Math/Science Conference will emphasize the microcomputer as a medium for instruction, as a tool for research, and as an information manager. Workshops, demonstrations, panel discussions, and problem-solving groups will be featured. Contact Nancy Watson, 203 Payne Hall, Arizona State University, Tempe AZ 85287.

January 19-22

Peripheral Array Processors for Signal Processing and Simulation, Sheraton National Hotel, Washington DC. The fee for this course is $795. For complete details, contact the Continuing Education Institute, 10889 Wilshire Blvd, Suite 1030, Los Angeles CA 90024, (213) 824-9545.

January 19-22

The Which Computer? Show, National Exhibition Centre, Birmingham, England. Information about this show can be obtained from Clapp & Poliak Inc, 245 Park Ave, New York NY 10167, (800) 223-1956; in New York (212) 661-8410.

January 20-22

Texas Computer Show, Dallas Convention Center, Dallas TX. Conferences, panel discussions, and seminars will be featured at this show. On display will be word- and data-processing equipment in addition to peripherals. For details, contact the Texas Computer Show, POB 214035, Dallas TX 75221, (214) 761-9108; in Georgia, (404) 452-0114; in Canada, (416) 252-7791.

January 28-30

Conference on Modeling and Simulation on Microcomputers, Bahia Hotel, San Diego CA. The Society for Computer Simulation (SCS) is presenting this conference. Papers, panel discussions, and tutorials on discrete and continuous simulation on microcomputers will be featured. Contact SCS, POB 2228, La Jolla CA 92038, (714) 459-3888.■

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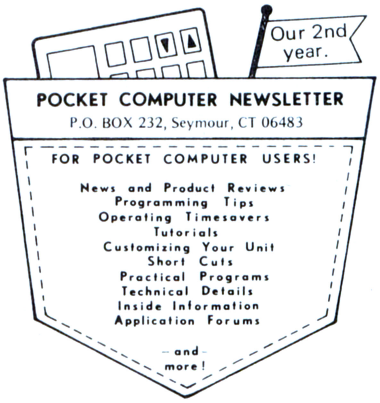

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Linking a Pascal Microengine to a Cyber 170

Steven M Sedlet
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Jonathan Dust
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POB 372
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Microcomputers now on the market offer the speed, memory capacity, mass storage, and programming-language support facilities formerly available only on large mainframe computers. As a result, personal computers give users a convenient, inexpensive alternative to computing on larger machines. Personal computers, however, cannot offer the wide range of software utilities and applications packages or the variety of I/O (input/output) facilities available on large systems. The desire to incorporate the finer qualities of both modes of computing has motivated us to establish a mechanism for information and resource sharing between a personal computer, the Western Digital Pascal Microengine, and a large Control Data Corp Cyber 170 mainframe.

We have developed a file-transfer system to allow communication between the two machines. The Pascal Microengine, a hardware realization of UCSD's (University of California at San Diego) P-machine, is a desktop microcomputer for developing and executing Pascal programs. It is driven by a 16-bit processor that directly executes UCSD's p-code. The operating system consists of a Pascal compiler, a file manager, and a screen-oriented text editor. Mass storage for the Microengine system is provided by two Shugart single-density, single-sided 800R floppy-disk drives. Two RS-232 serial ports allow communication with the Microengine. One port is used for connection to the console (a serial video terminal). The second one, the remote port, is used to connect other RS-232 devices to the system. In our configuration, the remote port is connected to the Cyber by means of a modem.

The interface enables you to perform interactive processing on both the Microengine and the Cyber from the Microengine console. File transfers can be performed in both directions, allowing information and resource sharing between the two computers. The file-transfer system is written in UCSD Pascal and resides on the Pascal Microengine.

Why Have We Done This?

The value of interfacing two machines, such as the Pascal Microengine and the Cyber, extends beyond the ability to share data. You may take advantage of the finer points of each computer, consolidating their features to form an extended machine. For example, the interface between the Microengine and the Cyber allows you access to both the convenience of the screen-oriented editor on the Microengine and the power of the line-oriented editor, text formatter, and the fast central-processing unit with extended word lengths on the Cyber.

The ability to share data also allows for storage flexibility. A Pascal program written for the Microengine might be too large to practically store on a Microengine disk, but it can be stored on the Cyber. On the other hand, if you have space available on Microengine disks, it will be cheaper to store programs there rather than pay for disk space on the Cyber. Using the interface, the Microengine can also use the I/O features of the Cyber, taking advantage of line printers, card readers, and plotters, for example.

File-Transfer System

The file-transfer-system program is stored as object code and executed on the Microengine. When run, the program establishes communication with the IAF (Interactive Facility) on the Cyber. You may log onto IAF and perform interactive processing on the Cyber under NOS (Network Operating System). The file-transfer program is initially in Emulator Mode. In this mode, you may perform interactive processing under IAF or return to the Microengine interactive system by entering a Control-E at the console keyboard. Processing under IAF can be resumed, without logging in again, by reexecuting the file-transfer-system object code. All file trans-

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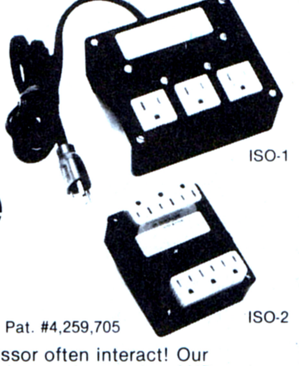

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fers must be performed in the IAF NULL subsystem.

While in Emulator Mode, you may continue interactive processing on the Cyber, or may enter one of the Control-key commands. These include Control-E (exit), Control-R (receive), Control-T (transmit), Control-S (switch character-set modes), and Control-A (assistance). Receive Mode allows for the transfer of files from the Cyber to the Microengine. Transmit Mode enables the transfer of files from the Microengine to the Cyber. (The names of the two modes of transfer reflect the concept that file transfers are initiated from the Microengine, that is, files are either received at or transmitted from the Microengine.)

Control-S enables switching of character-set modes. There are two character sets recognized by the Cyber, Normal and ASCII (American Standard Code for Information Interchange). You must transfer a file in the proper mode to insure conversion between Cyber and Microengine character representations. In ASCII mode, the Cyber recognizes uppercase and lowercase ASCII characters. This mode of transfer is used only for text (nonexecutable) files. Normal mode must be used for transferring program files to the Cyber. In this mode, all alphabetic characters are interpreted as uppercase. Control-A may be entered to receive a menu of the above control key commands. Listing 1a demonstrates the use of the S and A control key commands.

Listing 1b demonstrates the interaction between the user and the file-transfer system when transferring files from the Cyber to the Microengine in Receive Mode. The file-transfer system performs the transfer by fetching the file to be transferred from your Cyber disk space, performing the transfer, and then cataloging it on Microengine disk using the UCSD Pascal filer system.

To access Receive Mode, you must enter a Control-R from the console, while in Emulator Mode. You will then receive confirmation at the console screen and be prompted for the name under which the file is to be cataloged on Microengine disk and the name of the Cyber file to be transferred. The file must reside on your permanent file space on the Cyber. Files that are strictly local will not be transferred. In response to either prompt, you may enter STOP, in which case control will return to Emulator Mode without performing the transfer. If legal file names are entered, you will be asked if the file is to be echoed at the console screen while the transfer is being made. Once you have responded to this prompt, the transfer is initiated. You may abort the transfer while in progress by entering an S (stop) at the console keyboard. If the transfer is aborted, you will receive the message:

```
TRANSFER TERMINATED BEFORE
       COMPLETION
 —FILE NOT CATALOGED
```

and Emulator Mode will be resumed. Upon completion of a transfer, a message is written at the console and Emulator Mode is resumed.

Listing 1c demonstrates the command sequence during a transfer from the Microengine to the Cyber in Transmit Mode. To effect the transfer, the file is fetched from Microengine disk, transferred across the link to the Cyber, and cataloged in your Cyber disk space. The file will exist as the primary local file on the Cyber upon completion of the transfer.

Once Transmit Mode is entered, you will be prompted for the name of both the file to be transmitted and the name under which the file is to be cataloged on the Cyber. As in Receive Mode, you may enter STOP in response to either prompt in order to resume Emulator Mode without initiating the file transfer.

Once the file transfer has been initiated, it may be aborted by entering S at the console keyboard, in which case the message:

```
NO FILE TRANSFERRED
```

Text continued on page 476

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Listing 1: *Sample runs of the various file-transfer-system commands. In listing 1a, the Control-A (assistance) and Control-S (switch character sets) commands are displayed. In listing 1b, the Control-R (receive file from Cyber) command is shown. Listing 1c gives an example of the Control-T (transmit file to Cyber) command.*

(1a)

```
(control-A)   (* user wishes to see menu of control key commands *)

CONTROL-E--->EXIT TO UCSD SYSTEM.
CONTROL-S--->SHIFT TRANSFER MODES (NORMAL<--->ASCII).
CONTROL-R--->RECEIVE FILES.
CONTROL-T--->TRANSMIT FILES
CONTROL-A--->ASSISTANCE : DISPLAY MENU.

THIS INTERFACE OPERATES ONLY IN CDC NULL SUBSYSTEM.

(control-S)   (* user wishes to switch character set modes *)

PROGRAM FILES MUST BE TRANSFERRED IN CDC NORMAL MODE.
TEXT FILES (U/L CASE) MUST BE TRANSFERRED IN CDC ASCII MODE.
PLEASE ENTER TRANSFER MODE N=NORMAL OR A=ASCII---> A
ASCII MODE
```

(1b)

```
(control-R)   (* user wishes to transfer file, CYBER-Microengine *)

FILE TRANSFER - CYBER TO MICROENGINE
NOTE : CDC FILE TO BE TRANSFERRED MUST BE PERMANENT

ENTER MICROENGINE FILENAME , E.G.  FILENAME.TEXT
           OR ENTER "STOP" TO TERMINATE
prime.text
ENTER NAME UNDER WHICH THE FILE IS CATALOGED ON THE CYBER
primnum
DO YOU WISH THE FILE TO BE ECHOED AS IT IS TRANSFERRED?  (Y/N) Y
         :
         :

         [listing of file]

         :
         :
EOT ENCOUNTERED
PRIMNUM CLOSED AND CATALOGED
```

(1c)

```
(control-T)   (* user wishes to transfer file, Microengine-CYBER *)

FILE TRANSFER - MICROENGINE TO CYBER

ENTER NAME OF FILE TO BE TRANSMITTED FROM THE MICROENGINE
           OR ENTER "STOP" TO TERMINATE
           E.G.  FILENAME.TEXT
prime.text
ENTER CDC FILENAME, OR ENTER "STOP" TO TERMINATE
NOTE : FILE WILL BECOME A CDC PERMANENT FILE,
         OLD PRIMARY FILE WILL BE LOST
primenum
DO YOU WISH THE FILE TO BE ECHOED AS IT IS TRANSFERRED ?  (Y/N) N

TRANSFER COMPLETE
PRIMNUM IS A CDC PERMANENT FILE
```

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Text continued from page 474:

will appear at the console. If the transfer is allowed to run to completion, a message will be printed at the console. In either case, Transmit Mode will be terminated and Emulator Mode resumed.

File-Transfer Program

The file-transfer program that interfaces the Microengine to the Cyber (listing 2) is written in UCSD Pascal on the Microengine. It consists of three basic modules:

- the emulator
- the file transmit procedures (Microengine to Cyber)
- the file receive procedures (Cyber to Microengine)

The main program, which is the emulator, performs the communication between the Microengine console and the Cyber IAF system. It does this, alternately testing for input to the Microengine from the Cyber (remote port) and from the Microengine console (console port), by testing the status bits associated with each port. The status register for the console port is at address −1007 (two's complement) and the status register for the remote port is at address −991 (two's complement). Access to the status bit (bit 1 of the status registers) is achieved through a variant record:

```
type STATRG = record
   STATREG : packed array [0..7] of
             boolean
   end;
   STATREC = record
   case BVAR : boolean of
     TRUE : (STATREGADDR :
             integer ) ;
     FALSE : (STATPTR : STATRG)
   end;
```

The Boolean variable, BVAR, is originally set to true, and the variant field, STATREGADDR, is set to the address of the status register. This is done at the beginning of the file-transfer program. BVAR is then set false, making the variant field a

Text continued on page 486

Listing 2: *The emulator program, as written for the Pascal Microengine.*

```
PROGRAM EMULATOR ;

  (*                               JONATHAN DUST                   *)
  (*                               STEVEN SEDLET                   *)
  (*                               DEPARTMENT OF COMPUTER SCIENCE  *)
  (*                               COLORADO STATE UNIVERSITY       *)
  (*                               JUNE, 1980                      *)
  (* THIS PROGRAM PERFORMS THE FOLLOWING TASKS :                   *)
  (*    1. IT SERVES AS AN EMULATOR BETWEEN THE WESTERN DIGITAL    *)
  (*       PASCAL MICROENGINE AND THE CDC CYBER 171/172.  THE MAIN *)
  (*       PROGRAM ALLOWS A USER AT THE MICROENGINE CONSOLE TO LOG *)
  (*       INTO THE CYBER.                                         *)
  (*    2. IT PROVIDES FOR THE TRANSFER OF FILES FROM THE CYBER TO *)
  (*       THE MICROENGINE, AND FROM THE MICROENGINE TO THE CYBER. *)
  (*                                                               *)
  (* IT IS INTENDED THAT THE PROGRAM WILL ULTIMATELY BE USED TO    *)
  (* EFFECT THE TRANSFER OF FILES BETWEEN COMPUTERS CONNECTED TO   *)
  (* RIAS RING NETWORK.  MODIFICATION WILL BE REQUIRED FOR THIS    *)
  (* PURPOSE.                                                      *)
  (*                                                               *)
  (* THE PROGRAM MODULES CONSIST OF :                              *)
  (*    MAIN PGM - THE EMULATOR, ALLOWS USER TO LOG INTO CYBER.    *)
  (*    RECEIVEFILE - ALLOWS THE TRANSFER OF A FILE FROM THE CYBER *)
  (*                  TO THE MICROENGINE.                          *)
  (*    TRANSMITFILE - ALLOWS THE TRANSFER OF A FILE FROM THE      *)
  (*                   MICROENGINE TO THE CYBER.                   *)
  (*                                                               *)
  (* PROGRAM EXECUTION :                                           *)
  (*    THE PROGRAM IS WRITTEN IN UCSD PASCAL AND RESIDES ON MICRO-*)
  (*    ENGINE DISK.  TO INITIALLY EXECUTE THE PROGRAM, THE FILE,  *)
  (*    "EMULATOR.CODE" MUST BE FETCHED AND EXECUTED.  THE FILE    *)
  (*    "EMULATOR.TEXT" CONTAINS THE SOURCE CODE.  ONCE THE PRO-   *)
  (*    GRAM IS RUNNING, A CR WILL SOLICIT THE LOGIN MESSAGE FROM  *)
  (*    THE CYBER.                                                 *)
  (*                                                               *)
  (*    ONCE LOGGED IN, THE USER MAY ISSUE ANY LEGAL TELEX COMMAND,*)
  (*    AS WELL AS                                                 *)
  (*       CNTRL-E - EXITS EMULATOR AND RETURNS TO THE MICROENGINE *)
  (*                 INTERACTIVE SYSTEM.  RE-EXECUTION OF THE PRO- *)
  (*                 GRAM WILL RESUME TELEX, UNLESS THE USER HAS   *)
  (*                 BEEN TIMED-OUT IN THE MEANTIME.  WHEN         *)
  (*                 LOGGING OUT USING "BYE", HIT CNTRL-E AFTER    *)
  (*                 RECEIVING LOGOUT MESSAGE, THEN TURN OFF MODEM.*)
  (*       CNTRL-R - PASSES CONTROL TO THE PROCEDURE "RECEIVEFILE",*)
  (*                 ALLOWING THE TRANSFER OF A FILE FROM THE CYBER*)
  (*                 TO THE MICROENGINE.                           *)
  (*       CNTRL-T - PASSES CONTROL TO PROCEDURE "TRANSMITFILE",   *)
  (*                 ALLOWING THE TRANSFER OF A FILE FROM THE      *)
  (*                 MICROENGINE TO THE CYBER.                     *)
  (*     IN THE LATTER 2 CASES THE PROGRAM WILL PROMPT THE USER FOR*)
  (*     NECESSARY INFORMATION.  IN BOTH CASES THE FILE TRANSFER   *)
  (*     CAN BE TERMINATED WITH A CNTRL-S.                         *)
  (*                                                               *)
  (* MAJOR DATA STRUCTURES :                                       *)
  (*    STATREC - RECORD USED TO ACCESS INDIVIDUAL BITS OF AN      *)
  (*              ADDRESS LOCATION, NECESSARY TO ALLOW EXAMINATION *)
```

Listing 2 continued on page 478

Listing 2 continued:

```
(*              OF THE SERIAL PORT STATUS REGISTERS FOR DETECTION*)
(*              OF INPUT FROM THE CYBER OR FROM THE CONSOLE. THE *)
(*              STRUCTURE IS ALSO USED TO CHANGE CERTAIN BITS OF *)
(*              THE SERIAL STATUS REGISTERS (PP. 34-42, PASCAL   *)
(*              MICROENGINE REFERENCE MANUAL).  INDIVIDUAL BIT   *)
(*              ACCESS IS IMPLEMENTED BY USING A RECORD CONSIST- *)
(*              OF A BOOLEAN FIELD AND A VARIANT FIELD. WHEN THE *)
(*              BOOLEAN IS TRUE, THE VARIANT PART IS AN INTEGER  *)
(*              & IS SET EQUAL TO THE ADDR OF A STATUS REGISTER. *)
(*              WHEN THE BOOLEAN IS SET FALSE, THE VARIANT PART  *)
(*              IS A POINTER INTO A PACKED ARRAY[0..7] OF        *)
(*              BOOLEAN, ALLOWING ACCESS INTO THE 8 INDIVIDUAL   *)
(*              BITS OF THE WORD.                                *)
(*              THE RECORDS OF THIS TYPE ARE :                   *)
(*                 STATREG1 - USED TO DETECT IF A CHARACTER HAS  *)
(*                            BEEN ENTERED FROM THE CONSOLE.     *)
(*                 STATREG8 - USED TO DETECT IF A CHARACTER HAS  *)
(*                            BEEN SENT BY THE CYBER.            *)
(*                 PARITYON, PARITYODD - SEE PP. 37-42           *)
(*    T - A ONE ELEMENT ARRAY USED TO HOLD THE CHARACTER WRITTEN/*)
(*        READ TO/FROM THE SERIAL PORTS.  AN ARRAY IS USED,      *)
(*        RATHER THEN A CHAR VARIABLE, BECAUSE THE UCSD PASCAL   *)
(*        COMMANDS, UNITREAD AND UNITWRITE, REQUIRE AN ARRAY.    *)

TYPE STATRG =  RECORD
                 STATREG : PACKED ARRAY [0..7] OF BOOLEAN
               END ;
     STATREC = RECORD
                 CASE BVAR : BOOLEAN OF
                   TRUE  : (STATREGADDR  :INTEGER) ;
                   FALSE : (STATPTR : sTATRG)
                 END ;
VAR T : PACKED ARRAY [0..2] OF CHAR ;
    FOREVER : BOOLEAN ;
    STATREG1,STATREG8 : STATREC ;
    SKIP : BOOLEAN ;
    ASCII : BOOLEAN ;

PROCEDURE ASCIIMODE ;
  (* THIS PROCEDURE SETS THE CYBER CHARACTER MODE TO ASCII       *)
  VAR M : PACKED ARRAY [1..12] OF CHAR ;
  BEGIN  (* PROC ASCIIMODE *)
    M:='CSET,ASCII  ';
    M[11]:=CHR(13);
    UNITWRITE(8,M,11,0,1);
    UNITWAIT(8);
    UNITREAD(8,M,11,0,1);
    UNITWAIT(8);
    WRITELN('ASCII MODE') ;
    WRITELN
  END ;  (* PROC ASCIIMODE *)

PROCEDURE CHARMODE ;
  (* THIS PROCEDURE ALLOWS THE USER TO SWITCH CYBER CHARACTER    *)
  (* MODES  (NORMAL <--> ASCII)                                  *)
  VAR M : PACKED ARRAY [1..12] OF CHAR ;
  BEGIN  (* PROC CHARMODE *)
```

Listing 2 continued:

```
    WRITELN ;
    WRITELN('PROGRAM FILES MUST BE TRANSFERRED IN A CDC NORMAL MODE.') ;
    WRITELN('TEXT FILES (U/L CASE) MUST BE TRANSFERRED IN A CDC ASCII MODE.');
    WRITE('PLEASE ENTER TRANSFER MODE N=NORMAL OR A=ASCII--->') ;
    UNITREAD(1,M,1,0,1) ;
    UNITWAIT(1) ;
    WRITELN ;
    IF (M[1]='A') OR (M[1]='a')
      THEN BEGIN
             ASCII := TRUE ;
             ASCIIMODE
           END
      ELSE BEGIN
             ASCII := FALSE ;
             M := 'CSET,NORMAL ' ;
             M[12] := CHR(13) ;
             UNITWRITE(8,M,12,0,1) ;
             UNITWAIT(8) ;
             UNITREAD(8,M,11,0,1) ;
             UNITWAIT(8) ;
             WRITELN('NORMAL MODE') ;
             WRITELN
           END ;
    WRITELN
  END ;  (* PROC CHARMODE *)

PROCEDURE RECEIVEFILE ;
  (* TRANSFER A FILE FROM THE CYBER TO THE MICROENGINE.           *)
  (*    THE TRANSFER IS PERFORMED BY GENERATING A TELEX "TAPE"    *)
  (*    COMMAND FOLLOWED BY A "LIST" COMMAND.  TAPE               *)
  (*    MODE IS ENTERED TO ENABLE DETECTION OF AN EOT (END OF     *)
  (*    TEXT) CHARACTER.  THE CYBER FILE TRANSFERRED MUST BE THE *)
  (*    PRIMARY FILE.  THE FILE IS TRANSFERRED TO A BUFFER, THEN *)
  (*    ONTO THE MICROENGINE DISK.  A "NORMAL" COMMAND IS THEN    *)
  (*    GENERATED TO EXIT TAPE MODE.  *WARNING : THE NORMAL COM- *)
  (*    MAND WILL CAUSE CANCELLATION OF ASCII MODE.               *)

  VAR DONE : BOOLEAN ;
      O : STRING ;
      N : PACKED ARRAY [1..13] OF CHAR ;
      P : PACKED ARRAY [1..13] OF CHAR ;
      FILENAME : STRING ;
      RCVEFILE : TEXT ;
      USERTERM : BOOLEAN ;
      VERIFY : BOOLEAN ;
      BUFF1 : PACKED ARRAY [1..32766] OF CHAR ;
      BUFFINDEX : INTEGER ;
      I : INTEGER ;
      M : PACKED ARRAY [0..20] OF CHAR;
      BYE : BOOLEAN ;

  PROCEDURE RCVEREADY;
    BEGIN  (* PROC RCVEREADY *)
      P[1]:=CHR(10) ;
      P[2]:=CHR(13) ;
      P[3]:=CHR(10) ;
      P[4]:='R' ;
```

Listing 2 continued on page 480

Listing 2 continued:

```
    P[5]:='E' ;
    P[6]:='A' ;
    P[7]:='D' ;
    P[8]:='Y' ;
    P[9]:='.' ;
    P[10]:=' ' ;
    P[11]:=' ' ;
    P[12]:=CHR(13) ;
    P[13]:=CHR(10) ;
    IF P = N
      THEN BYE := FALSE
      ELSE BEGIN
             BYE := TRUE ;
             WRITELN('ERROR-CDC FILENAME NOT FOUND-CHK DIRECTORY')
           END
  END ;  (* PROC RCVEREADY *)

PROCEDURE LISTFILE ;
  BEGIN  (* PROC LISTFILE *)
    M[0] := 'T' ;
    M[1] := 'A' ;
    M[2] := 'P' ;
    M[3] := 'E' ;
    M[4] := CHR(13) ;
    UNITWRITE(8,M,5,0,1) ;
    UNITWAIT(8) ;
    UNITREAD(8,M,6,0,1) ;
    UNITWAIT(8) ;
    M[0] := 'L' ;
    M[1] := 'I' ;
    M[2] := 'S' ;
    M[3] := 'T' ;
    M[4] := CHR(13) ;
    UNITWRITE(8,M,5,0,1) ;
    UNITWAIT(8)
  END ;  (* PROC LISTFILE *)

BEGIN  (* PROC RECEIVEFILE *)
  CHARMODE;
  WRITELN('FILE TRANSFER - CYBER TO MICROENGINE') ;
  WRITELN('NOTE : CDC FILE TO BE TRANSFERRED MUST BE PERMANENT') ;
  WRITELN ;
  WRITELN('ENTER MICROENGINE FILENAME, E.G. FILENAME.TEXT') ;
  WRITELN('      OR ENTER "STOP" TO TERMINATE') ;
  READLN(FILENAME) ;
  IF FILENAME<>'STOP
    THEN BEGIN
           WRITELN('ENTER NAME UNDER WHICH THE FILE IS',
                   'CATALOGED ON THE CYBER') ;
           READLN(O) ;
           WRITE('DO YOU WISH THE FILE TO BE ECHOED AS IT IS',
                   ' TRANSFERRED ?  (Y/N) ') ;
           UNITREAD(1,T,1,0,1) ;
           UNITWAIT(1);
           WRITELN ;
           IF T[0] = 'Y'
```

```
             THEN VERIFY := TRUE
             ELSE VERIFY := FALSE ;
           M[0]:='O' ;
           M[1]:='L' ;
           M[2]:='D' ;
           M[3]:=',' ;
           FOR I :=1 TO LENGTH(O) DO
           M[I+3] := O[I] ;
           M[LENGTH(O)+4]:=CHR(13) ;

 I:=(LENGTH(O)+5) ;
 UNITWRITE(1,M,I,0,1) ;
 UNITWRITE(8,M,I,0,1) ;
 UNITREAD(8,M,13,0,1) ;
 UNITWAIT(8) ;
 FOR I:=0 TO 12 DO N[I+1] := M[I]
 RCVEREADY ;
 IF BYE=TRUE
   THEN EXIT(RECEIVEFILE)
   ELSE LISTFILE ;
 USERTERM := FALSE ;
 DONE := FALSE ;
 BUFFINDEX := 0 ;
 WHILE (NOT DONE) AND (NOT USERTERM) DO
   BEGIN
     BUFFINDEX := BUFFINDEX + 1 ;
     UNITREAD(8,T,1,0,1) ;
     UNITWAIT(8);
     IF ORD(T[0]) = 17 THEN DONE := TRUE ;
     IF ORD(T[0]) = 13
       THEN BEGIN
              IF VERIFY THEN WRITELN
            END
       ELSE IF ORD(T[0]) <> 10 THEN IF VERIFY THEN WRITE(T[0]) ;
     BUFF1[BUFFINDEX] := T[0] ;
     IF STATREG1.STATPTRSTATREG[1] = TRUE
       THEN BEGIN
              UNITREAD(1,T,1,0,1) ;
              UNITWAIT(1) ;
              IF ORD(T[0]) = 19 THEN USERTERM := TRUE
            END
   END ;
 IF NOT USERTERM
   THEN BEGIN
           M:='NORMAL              ' ;
           M[6]:=CHR(13) ;
           UNITWRITE(8,M,7,0,1) ;
           UNITWAIT(8) ;
           UNITREAD(8,M,9,0,1) ;
           UNITWAIT(8) ;
           IF ASCII=TRUE THEN ASCIIMODE ;
           WRITELN('EOT ENCOUNTERED') ;
           REWRITE(RCVEFILE,FILENAME) ;
           FOR I := 1 TO BUFFINDEX DO
             IF ORD(BUFF1[I])=13
               THEN WRITELN(RCVEFILE)
```

Listing 2 continued on page 482

Listing 2 continued:

```
                    ELSE IF ORD(BUFF1[I]) <> 10
                                THEN WRITE(RCVEFILE,BUFF1[I]) ;
                CLOSE(RCVEFILE,LOCK) ;
                WRITELN ;
                WRITELN(FILENAME,' CLOSED AND CATALOGED')
               END
              ELSE BEGIN
                    T[0] := 'S' ;
                    UNITWRITE(8,T,1,0,1) ;
                    UNITWAIT(8) ;
                    UNITREAD(8,T,15,0,1) ;
                    UNITWAIT(8) ;
                    WRITELN ;
                    WRITELN ;
                    WRITELN('TRANSFER TERMINATED BEFORE COMPLETION',
                                ' - FILE NOT CATALOGED')
                   END ;
          END
      ELSE WRITELN('NO FILE TRANSFERRED')
  END ;  (* PROC RECEIVEFILE *)


 PROCEDURE TRANSMITFILE ;
  (* TRANSFER A FILE FROM THE MICROENGINE TO THE CYBER.           *)
  (*    TRANSFER IS PERFORMED BY CREATING A PRIMARY CYBER FILE,   *)
  (*    ENTERING TEXT MODE, AND TRANSMITTING THE MICROENGINE FILE*)
  (*    TO THE CYBER.  AFTER THE FILE IS TRANSFERRED, A "BREAK"   *)
  (*    (CNTRL-C) IS GENERATED, FOLLOWED BY A "PACK" COMMAND.     *)
  (*    THE TRANSFERRED M.E. FILE IS THEN THE CDC PRIMARY FILE,   *)
  (*    AND MUST BE SAVED IF THE USER WISHES TO RETAIN IT.        *)
  (*    IF THE TRANSFER IS TERMINATED BY A CNTRL-S, THE REST OF   *)
  (*    THE FILE IS READ AND BLANK LINES TRANSMITTED TO THE       *)
  (*    CYBER.  THIS IS NECESSARY DUE TO THE TIMING CONSTRAINTS   *)
  (*    BETWEEN THE TWO COMPUTERS.                                *)

  VAR DONE : BOOLEAN ;
      Z    : INTEGER ;
      X    : STRING ;
      FILENAME : STRING ;
      TRANSFILE : TEXT ;
      CDCFILENAME : STRING ;
      USERTERM : BOOLEAN ;
      VERIFY : BOOLEAN ;
      CH : CHAR ;
      I : INTEGER ;
      M : PACKED ARRAY [0..20] OF CHAR ;

  PROCEDURE XMITRDFILE ;
  (* THIS PROCEDURE TRANSMITS A CHARACTER FROM THE MICROENGINE    *)
  (* TO THE CYBER.                                                *)

    BEGIN  (* PROC XMITRDFILE *)
      READ(TRANSFILE,CH) ;
      T[0] := CH ;
      IF NOT USERTERM
         THEN BEGIN
```

Listing 2 continued:

```
              UNITWRITE(8,T,1,0,1) ;
              UNITWAIT(8) ;


              IF VERIFY THEN WRITE(T[0])
            END  ;
    IF EOLN(TRANSFILE)
       THEN BEGIN
              IF (NOT USERTERM) AND (VERIFY)
                 THEN WRITELN ;
              T[0] := CHR(13) ;
              T[1] := CHR(10) ;
              UNITWRITE (8,T,2,0,1) ;
              UNITWAIT(8) ;
              READLN(TRANSFILE)
            END  ;
    IF STATREG1.STATPTRSTATREG[1] = TRUE
       THEN BEGIN
              UNITREAD(1,T,1,0,1) ;
              UNITWAIT(1) ;
              IF ORD(T[0]) = 19 THEN USERTERM := TRUE
            END
  END ;  (* PROC XMITRDFILE *)

PROCEDURE REPLACEFILE ;
  BEGIN  (* PROC REPLACEFILE *)
    X:='REP';
    FOR I := 0 TO (LENGTH(X)-1) DO
    M[I] := X[I+1] ;
    M[3] := CHR(13) ;
    UNITWRITE(8,M,4,0,1) ;
    UNITWAIT(8) ;
    UNITREAD(8,M,13,0,1) ;
    UNITWAIT(8)
  END ;  (* PROC REPLACEFILE *)


BEGIN  (* PROC TRANSMITFILE *)
  CHARMODE ;
  WRITELN('               FILE TRANSFER - MICROENGINE TO CYBER') ;
  WRITELN('ENTER NAME OF FILE TO BE TRANSMITTED FROM MICROENGINE') ;
  WRITELN('OR ENTER "STOP" TO TERMINATE') ;
  WRITELN('E.G. FILENAME.TEXT') ;
  READLN(FILENAME) ;
  IF FILENAME <> 'STOP           '
    THEN BEGIN
           RESET(TRANSFILE,FILENAME) ;
           WRITELN(FILENAME, ' OPENED') ;
           WRITELN ;
           WRITELN('ENTER CDC FILENAME, OR ENTER "STOP" TO TERMINATE') ;
           WRITELN('NOTE : FILE WILL BECOME A CDC PERMANENT FILE, ',
                   'OLD PRIMARY FILE WILL BE LOST') ;
           READLN(CDCFILENAME) ;
           IF CDCFILENAME <> 'STOP   '
             THEN BEGIN
                    WRITELN ;
```

Listing 2 continued on page 484

Listing 2 continued:

```
WRITE('DO YOU WISH THE FILE TO BE ECHOED',
      AS 'IT IS TRANSFERRED ? (Y/N) ') ;
UNITREAD(1,T,1,0,1) ;
WRITELN ;
IF T[0] = 'Y'
  THEN VERIFY := TRUE
  ELSE VERIFY := FALSE ;
M[0] := 'N' ;
M[1] := 'E' ;
M[2] := 'W' ;
M[3] := ',' ;
FOR I := 1 TO LENGTH(CDCFILENAME) DO
  M[I+3] := CDCFILENAME[I] ;
M[LENGTH(CDCFILENAME) + 4] := CHR(13) ;
Z := (LENGTH(CDCFILENAME))+5 ;
UNITWRITE(8,M,Z,0,1) ;
UNITWAIT(8) ;
UNITREAD(8,M,13,0,1) ;
UNITWAIT(8) ;
M[0] := 'T' ;
M[1] := 'E' ;
M[2] := 'R' ;
M[3] := ',' ;
M[4] := 'B' ;
M[5] := 'L' ;
M[6] := 'K' ;
M[7] := 'E' ;
M[8] := 'D' ;
M[9] := 'T' ;
M[10] := CHR(13) ;
UNITWRITE(8,M,11,0,1) ;
UNITWAIT(8) ;
UNITREAD(8,M,11,0,1) ;
UNITWAIT(8) ;
M[0] := 'T' ;
M[1] := 'E' ;
M[2] := 'X' ;
M[3] := CHR(13) ;
M[4] := CHR(10) ;
UNITWRITE(8,M,5,0,1) ;
UNITWAIT(8) ;
UNITREAD(8,M,18,0,1) ;
UNITWAIT(8) ;
DONE := FALSE ;
USERTERM := FALSE ;
WRITELN ;
WHILE NOT EOF(TRANSFILE) DO XMITRDFILE;
M[0] := CHR(13) ;
M[1] := CHR(10) ;
M[2]:=CHR(3) ;
UNITWRITE(8,M,3,0,1) ;
UNITWAIT(8) ;
UNITREAD(8,M,18,0,1) ;
UNITWAIT(8) ;
M[0] := 'T' ;
M[1] := 'E' ;
```

Circle 463 on inquiry card.

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Circle 121 on inquiry card.

Listing 2 continued:

```
                      M[2] := 'R' ;
                      M[3] := ',' ;
                      M[4] := 'T' ;
                      M[5] := 'T' ;
                      M[6] := 'Y' ;
                      M[7] := CHR(13) ;
                      M[8] := CHR(10) ;
                      UNITWRITE(8,M,9,0,1) ;
                      UNITWAIT(8) ;
                      UNITREAD(8,M,10,0,1) ;
                      UNITWAIT(8) ;
                      M[0] := 'P' ;
                      M[1] := 'A' ;
                      M[2] := 'C' ;
                      M[3] := CHR(13) ;
                      UNITWRITE(8,M,4,0,1) ;
                      UNITWAIT(8) ;
                      UNITREAD(8,M,13,0,1) ;
                      UNITWAIT(8) ;
                      REPLACEFILE ;
                      IF NOT USERTERM
                        THEN WRITELN('TRANSFER COMPLETE')
                        ELSE WRITELN('TRANSFER TERMINATED BEFORE COMPLETION') ;
                      WRITELN(CDCFILENAME, ' IS A CDC PERMANENT FILE')
                    END
               ELSE WRITELN('NO FILE TRANSFERRED')
           END
      ELSE WRITELN('NO FILE TRANSFERRED')
  END ;  (* PROC TRANSMITFILE *)

PROCEDURE PRNTHELP ;
  (* THIS PROCEDURE PRINTS OUT THE MENU OF CONTROL KEY COMMANDS. *)

  BEGIN  (* PROC PRNTHELP *)
    WRITELN ;
    WRITELN ;
    WRITELN(' CONTROL-E--->EXIT TO UCSD SYSTEM.') ;
    WRITELN(' CONTROL-S--->SHIFT TRANSFER MODES (NORMAL<-->ASCII).') ;
    WRITELN(' CONTROL-R--->RECEIVE FILES.') ;
    WRITELN(' CONTROL-T--->TRANSMIT FILES.') ;
    WRITELN(' CONTROL-H--->DISPLAY ABOVE CONTROL COMMANDS.') ;
    WRITELN
  END ;  (* PROC PRNTHELP *)

  BEGIN  (* MAIN PROGRAM - TERMINAL EMULATOR *)
    PRNTHELP ;
    WRITELN(' PLEASE TYPE RETURN FOR LOGIN MESSAGE IF NOT LOGGED IN.');
    STATREG1.BVAR := TRUE ;
    STATREG8.BVAR := TRUE ;
    STATREG1.STATREGADDR := -1007 ;
    STATREG8.STATREGADDR := -991 ;
    STATREG1.BVAR := FALSE ;
    STATREG8.BVAR := FALSE ;
    UNITCLEAR(8) ;
    UNITCLEAR(1) ;
    FOREVER := TRUE ;
    WHILE FOREVER DO
```

Listing 2 continued on page 486

Text continued from page 476:

pointer into a Boolean packed array. Since the memory address associated with this field has been previously set to the address of the status register, and because a pointer type is merely an address of a memory location, we now have a pointer into the individual bits of the status register.

In Emulator Mode, the status bits associated with the two ports are alternately tested. If input is detected at the remote port, a *unitread* instruction is executed to fetch the character, followed by a *unitwrite* command to the console. These instructions are UCSD Pascal low-level intrinsics for accessing a peripheral device. Linefeeds (ASCII character 10) are not echoed. At the end of a line, the Cyber transmits a carriage return followed by a linefeed. On the Microengine a carriage return implies a linefeed, so the linefeed from the Cyber is redundant. If input is detected at the console port, a "unitread" is initiated to fetch the character. The character is first checked to determine if it is one of the previously discussed control-key commands, in which case the appropriate action is taken. If the character is not a control character, the emulator assumes it is meant for the Cyber, and it is transferred to the remote port by execution of a "unitwrite" command.

Input to the remote port is given priority over input to the console port so that the stream from the Cyber is not interrupted. This is implemented by placing the code for testing the remote-port status bit in a "while" loop and the code for testing the console-port status bit in an "if" statement in the main program. As long as characters are being received at the remote port, the emulator will continue to read them and echo them to the console. Only when there are no more characters detected at the remote port is the console-port status bit checked. Even then, only one character is accepted before the remote-port status bit is again tested. Consequently, characters entered at the console while information is being sent by the Cyber are displayed, but ignored.

Listing 2 continued:

```
           BEGIN
             WHILE STATREG8.STATPTRSTATREG[1]=TRUE DO
               BEGIN
                 UNITREAD(8,T,1,0,1) ;
                 UNITWAIT(8) ;
                 IF ORD(T[0]) <> 10
                   THEN BEGIN
                          UNITWRITE(1,T,1,0,1) ;
                          UNITWAIT(1)
                        END
               END ;
             IF STATREG1.STATPTRSTATREG[1]=TRUE
               THEN BEGIN
                      UNITREAD(1,T,1,0,1) ;
                      UNITWAIT(1) ;
                      SKIP := FALSE ;
                        IF ORD(T[0])=05
                          THEN BEGIN
                                 FOREVER := FALSE ;
                                 SKIP := TRUE
                               END ;
                        IF ORD(T[0])=18
                          THEN BEGIN
                                 RECEIVEFILE ;
                                 SKIP := TRUE
                               END ;
                        IF ORD(T[0])=20
                          THEN BEGIN
                                 TRANSMITFILE ;
                                 SKIP := TRUE
                               END ;
                        IF ORD(T[0])=19
                          THEN BEGIN
                                 CHARMODE ;
                                 SKIP := TRUE
                               END ;
                        IF ORD(T[0])=08 THEN PRNTHELP ;
                        IF SKIP=FALSE
                          THEN BEGIN

                          UNITWRITE(8,T,1,0,1) ;
                          UNITWAIT(8)
                        END
             END
    END
END.
```

File transfer from the Cyber to the Microengine is performed by the procedure RECEIVEFILE. The transfer is implemented by generating an

OLD, filename

IAF command to fetch the file from your Cyber file space. The procedure then waits for a READY response from the Cyber. If it does not receive the response, the routine assumes that the file was not found, that is, the Cyber actually generated a

filename NOT FOUND

response.

In the latter case, an error message is printed at the console and Emulator Mode is resumed. You must then reenter Receive Mode to reattempt the file transfer. It is because of this type of response by the Cyber that file transfers must be performed in the IAF NULL subsystem. The response made by IAF to commands differs between IAF subsystems, and the file-transfer program was designed to accommodate the responses made in the NULL subsystem.

If the file is successfully fetched, the routine generates a TAPE command, causing the Cyber to enter the TAPE subsystem under IAF. Performing the transfer in this subsystem is necessary since it is only in this mode that the Cyber generates an EOT (end-of-text) character to allow detection of transfer completion. The actual transfer is initiated by generating an IAF LIST command.

The transfer is performed by reading the listed output from the Cyber, at the remote port, into a buffer in Microengine memory, BUFF1, consisting of an array of characters. Upon completion of the transfer, BUFF1 is written to Microengine disk. It is necessary to use this intermediate storage because of the activity of the Microengine disk-drive head as a file is written. At certain intervals as it is writing, the head must position itself to available partitions. In doing so, it misses a few characters, since the Cyber will not withhold its transmission to allow positioning of the disk head. This, of course, is allowed for when writing from Microengine memory to disk, and so the writing of the file to Microengine disk is postponed until the file transfer is completed. (Because of this use of intermediate storage, the size of Microengine memory places a limit of 32,767 characters on the size of files received from the Cyber.)

During the transfer, certain characters must be noted. If you have requested echoing of the file to the console as it is transferred, a "writeln" command must be generated if a carriage return (ASCII character 13) is detected from the Cyber. As in Emulator Mode, a linefeed is redundant and must not be echoed to the screen.

The detection of an EOT (ASCII character 17) indicates the completion of the transfer. If the transfer is terminated by detection of an EOT character, a suitable message is written to the console, BUFF1 is written to Microengine disk, the file is cataloged and closed, and Emulator Mode is resumed.

If, during file transfer, an S is entered at the console keyboard, it is transmitted to the Cyber, causing the listing of the file to be terminated. A termination message is written to the console screen and Emulation Mode is resumed without writing BUFF1 to Microengine disk.

Since IAF was placed in the TAPE subsystem in order to enable the detection of an EOT mark, it must now be returned to the NULL subsystem. This is done, before returning to Emulator Mode, by generating a Normal command to IAF. If, however, you have been operating in ASCII Mode, you will want to remain in that mode. To this purpose, a Boolean variable, ASCII, is maintained to keep track of the character mode. If ASCII is true, the character-set mode is switched to ASCII before returning to Emulator Mode.

Transmission of a file from the Microengine to the Cyber is performed by the procedure TRANSMITFILE. After you are prompted for the name of the Microengine file to be transferred, the file is opened and you will be prompted for the name under which the file is to be cataloged on the Cyber. Keying in STOP in place of either file name will terminate Transmit Mode and resume Emulator Mode without initiating the transfer. The transfer is performed by generating a

```
NEW, Cyber filename
```

IAF command, thus creating a new primary local file on the Cyber and listing the Microengine file to the Cyber. Since a new primary file is created, the user must take care to

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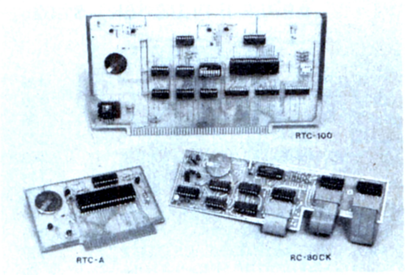

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save the old primary file before entering Transmit Mode.

Before the transfer is initiated, BLKEDIT mode is entered in IAF by generating a

TERM,BLKEDIT

command. BLKEDIT mode is designed to allow multiple-line input from a terminal to the Cyber, rather than line-by-line transmission. In this mode, the file transmission can be viewed as a stream of characters instead of a series of lines. Thus, the Microengine does not have to wait for the Cyber to accept each line before transmitting the next.

Following the command, a

TEXT

IAF command is generated to allow the file transmitted from the Microengine to be read into the newly defined CYBER file. Then, the nested procedure XMITRDFILE performs the transfer. When the transfer is completed, BLKEDIT mode is terminated and Cyber filename is cataloged on the Cyber by generation of TERM, TTY, and REPLACE IAF commands.

In addition to the two transfer routines (with nested procedures) and the emulator (main) routine, there are two other procedures:

1. CHARMODE allows the user to choose the character-set mode (Normal or ASCII) for file transfer. It is accessed by entering a Control-S while in Emulator Mode.

2. PRNTHELP lists the menu of control commands available to the user in Emulator Mode. PRNTHELP is accessed by entering Control-A while in Emulator Mode.

Limitations, Tradeoffs, Extensions

Our file-transfer system has been used extensively at data rates up to 1200 bps (bits per second) and has proven successful in its intended purpose. The system does contain some limitations, however, either due to tradeoffs between versatility and simplicity or as a result of the inherent qualities of the machines. One such limitation is the constraint that all file transfers must be performed under the Cyber NULL subsystem. As described earlier, this is necessary since the program must test for certain responses from the Cyber. Originally, a "busy wait," in the form of an empty Pascal "for" loop, was used to halt program execution until the Cyber had generated its response. In this way, the Microengine did not have to wait for a specific response, but only had to make sure that it gave the Cyber sufficient time to generate it. Because of the variation in response time by the Cyber, coupled with the rapid processing of the Microengine, the range of the loop bounds had to be made very large to insure that the Cyber had completed its response before the Microengine resumed execution of the file-transfer program. So instead of employing the "busy wait," the program was tailored to the responses made by the Cyber in the NULL subsystem. This approach was cleaner and more efficient but was chosen at the cost of

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versatility. The program can be extended to accept responses made under other subsystems as well, but this would lengthen the program size considerably.

Another such limitation is the restriction on the size of files transferred from the Cyber to Microengine disk, due to the use of a memory buffer. A large file can be transferred by dividing it into smaller files on the Cyber, transmitting the files separately and merging them at the Microengine. If more memory is available, the buffer size can be increased to allow the transfer of large files.

The file-transfer system might also be extended to allow the transfer of object-code files. Due to the incompatibility of binary codes on the two machines, a remapping of the codes would be required for file transfers in both directions. Again, this enhancement would considerably increase the size of the transfer program.

When we designed the file-transfer system, we intended it to be adapted, with minimal modification, to other microcomputers and minicomputers. The program was also designed for eventual use as a skeleton of a file-transfer system for a network of computers in the Department of Computer Science at Colorado State University.

At present, the system has been adapted to an Altair 8800 and an Intertec SuperBrain. The primary modification made to the program, in order to adapt it to the Altair, was in the emulator section. In the Microengine, the serial-port status registers are memory-mapped and can be tested using the Pascal record construct presented earlier. The ports on the Altair cannot be tested in this manner. The UCSD Pascal system allows assembly-language linking to Pascal programs, however, and so the adaptation to the Altair was made possible by the addition of two assembly-language functions, one to test the port to the Cyber and one to test the port connected to the system console. (The listing of modifications to the file-transfer-system program can be obtained from the authors.)■

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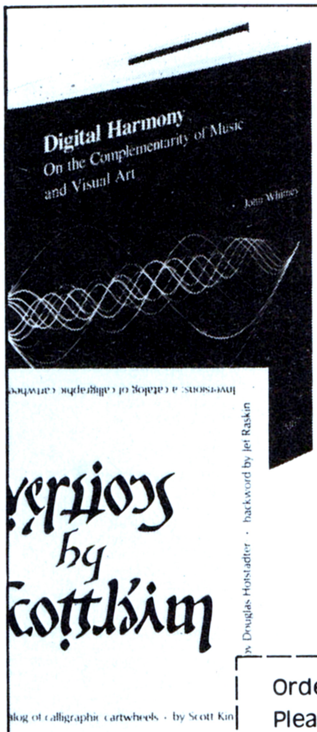
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Microcomputer Power Series, Introduction to Graphics. Same as above; 144 pages, softcover, ISBN 0-697-09953-9, $15.95.

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The Year of the Robot, Wayne Chen. Beaverton OR: dilithium Press, 1981; 13.5 by 21 cm, 182 pages, softcover, ISBN 0-918398-50-9, $7.95.■

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Circle 320 on inquiry card.

Information Hiding in Pascal

Packages and Pointers

Michael B Feldman
Department of Electrical Engineering and Computer Science
The George Washington University
Washington DC 20052

Information hiding is the principle that allows programs written at a *high level* to be insulated from messy *low-level* details. This principle fosters program reliability for two related reasons:

- Since low-level details are relegated to lower-level programs (procedures, functions, macroinstructions, etc), they can, in principle, be coded *once*, instead of once per program. Thus, the detailed code need be debugged only once. Moreover, the calling programs cannot disturb them because they cannot gain access to these details.
- High-level programs, being insulated from low-level details, can be written more cleanly, making them easier to maintain. Since higher-level programmers know that lower-level details have already been debugged, they can concentrate on their assigned task—writing the higher-level material.

Information hiding is equally valid for single- and multi-programmer tasks. It is clear that even a single programmer can benefit from writing low-level code only once.

What Is a Package?

One important application of the information-hiding principle is in the definition, in some programming language, of new data types not already supported. Pascal, for example, does not support complex numbers—at least in the standard language. A *package*, also called a *class* or *data abstraction*, is an encapsulation of a new data type, together with a set of primitive functions or procedures that handles the details of creating instances of the new type and performing operations on it.

To continue with our example of complex numbers, a complex-number package generally contains the following parts:

- a definition of complex data as consisting of a real part and an imaginary part
- a method to be used by higher-level programs in creating new complex data, given two integers or real numbers to serve as the real and imaginary components
- a set of operations on complex numbers so higher-level programs can do arithmetic on complex numbers without needing access to the details of what complex numbers look like internally

Such a set of operations should ordinarily be *minimal* (without redundant operations) and *complete* (ie: calling routines don't need any additional operations to do everything required). For complex numbers, we would need sum, difference, product, quotient, and absolute value or magnitude operations, plus some comparison operations, such as equals, less than, greater than, etc. The general idea is that this extended data type "comes with" the same general level of support offered by the base language for integers and real numbers.

Ideally, a package should be defined by two pieces: a *functional specification* of the type and its operations, which gives a list of the legal operations and a description of *what* each operation does (not *how*), and a *group of programs* implementing the operations and responsible for handling the messy lower-level details.

Jean Ichbiah, developer of the new Ada language, explains the package idea by referring to a wristwatch—say, one of the new digital ones with many features. The owner's guide describes the watch's features, explaining what each button does (time, date, light, set alarm, and so on). The user receives a warranty from the manufacturer that the watch will perform as advertised. It is not necessary to know anything about how the watch works to use it effectively. Furthermore, the manufacturer would probably refuse to honor the warranty on a watch whose internal circuits have been tampered with. So, the internal parts of a watch are—we hope—packaged to discourage tampering. Indeed, more complex equipment is often packaged with a lock or seal. This way, only an authorized technician can get inside, or an attempt by a user to get in will be obvious and void the warranty.

Ichbiah asserts that software producers are going to be called upon more and more to guarantee their products. However, it will be difficult to give an effective warranty on products whose reliability has not been proven (at least to our own satisfaction; recalls occur in many industries). More important, it is difficult to guarantee a product whose internal parts can be tampered with by a user. Packages, then, are a way to foster warrantableness.

There are several programming languages that support variations on the package theme. The language SIMULA67, used more in Europe than in the United States, provides a similar concept called *class*; experimental languages such as Concurrent Pascal, CLU, and Alphard support the idea in one form or another, and Ada emphasizes packages by that name as an important principle of modular design. Standard Pascal does not support packages as such; let us examine how we can implement their principle in Pascal.

Packages in Standard Pascal

A package should consist of a functional specification—ideally recognized by the compiler—and an implementation module. Pascal has no facility for separating the specification part from the implementation part. Therefore, we write the specification part, in an appropriate style, as a block comment.

Also implicit in the notion of a package is the fact that we can physically isolate the package from other packages and calling programs. Unfortunately, Pascal is not much help here, since neither a compile-time facility for copying separate pieces of source text into a source file nor a facility for separate compilation of packages is supported. Many implementations of Pascal provide one or both of these, but this discussion is limited to the possibilities of the standard language.

Another limitation of Pascal is that all type definitions must appear in one group following a "type" keyword, and these must appear before all code for functions and procedures. This hinders the ability to group a type definition with all its operations, another type to be grouped with its operations, and so on. Once again, there are some implementation-dependent relaxations of this rule.

A Pascal Complex-Number Package

To summarize the previous sections, Pascal does not permit the *direct* production of packages because of its lack of separate compilation facilities and its rigid syntax for defining new types. With some good programming-style conventions, however, and perhaps a bit of manual preprocessing of the source code, a fairly good approximation can be achieved.

How shall we implement a complex-number package? Let us define a Pascal type called COMPLEX as a record with real and imaginary components:

```
type COMPLEX =
  record REALPART: real;
         IMAGPART: real
  end;
```

We could then declare variables of type COMPLEX:

```
var A, B, C, D, E, F: COMPLEX;
```

and set A, B, and C as follows:

```
A.REALPART := 1.5; A.IMAGPART := −3.7;
B.REALPART := 2.0; B.IMAGPART := −5.1;
C.REALPART := 0.0; C.IMAGPART := 4.1.
```

How shall we do arithmetic on complex numbers? Suppose we defined a procedure:

```
procedure CADD(C1, C2: COMPLEX; var
RESULT: COMPLEX)
```

The complex sum RESULT is a complex number that gives:

```
RESULT.REALPART := C1.REALPART +
C2.REALPART;
RESULT.IMAGPART := C1.IMAGPART +
C2.IMAGPART
```

STOP!

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Writing this procedure would be quite straightforward, and we could do the equivalent of saying $D = A + B$ by writing:

CADD(A,B,D)

Things start looking messier when we try to emulate a more complicated expression like $D = A + B + C$. We would then have to write something like:

CADD(A,B,E); CADD(C,E,D)

As the expression gets longer, we need more separate calls to the CADD procedure, each doing only a single operation. It would be better if we could write an *expression*, as we would if we were dealing with integers or real numbers. In other words, can we turn CADD into a *function*, then write:

D := CADD(A, CADD(B,C))

which is much cleaner (especially in longer expressions)?

Writing functions to do this operation, and others like difference, product, quotient, etc, would be easy if our Pascal functions looked like:

function CADD (C1, C2 : COMPLEX) : COMPLEX

that is, if functions could return complex numbers as value. Pascal sets up an obstacle here: functions can return only *scalar* types, and COMPLEX is a *structured* type, a record. What can we do?

Enter the Pointer

What is a pointer? It is an abstraction of the idea "the data at the address: ..." Pointers exist in many programming languages, notably PL/I. A pointer in Pascal is written in publication language as ↑. Since many implementations use the symbol @ instead, we shall use it as well.

In Pascal, you can declare a variable to be a pointer:

var P: @INTEGER

which is read "P is a pointer to an integer." Pascal, differing from PL/I, for example, requires not only a declaration of all pointers, but also a declaration of the type of thing pointed to. This is a protection against using pointers indiscriminately to point to different things at different times and is a reflection of the Pascal "strong-typing" philosophy. P@ is read "the thing pointed to by P."

Pointers must be used with care. In fact, it is often said that "pointers are to data what GOTOs are to program code." But in appropriate situations, pointers in Pascal are extremely useful.

Pascal textbooks illustrate pointers as a way to link nodes in a list or tree structure, and many of you are familiar with this application. What is not usually

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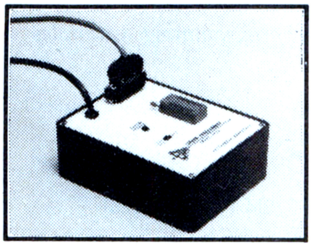

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discussed in the texts is, first, that pointers don't have to be used as that kind of link, and second, that pointers are scalar types, and thus may be returned as function values.

Listing 1: *Pascal programming examples (see the text for details).*

(1a)

```
type COMPNUM =
  record
        REALPART, IMAGPART: real
  end;
        COMPLEX = @COMPNUM
```

(1b)

```
function MAKECOMP (R,I: real): COMPLEX;
var P: COMPLEX;
begin NEW (P);
        P@.REALPART := R; P;. IMAGPART := I;
        MAKECOMP := P
end;
```

(1c)

```
function RE( C: COMPLEX): real;
  begin RE := C@.REALPART end;
function IM( C: COMPLEX): real;
  begin IM := C@.IMAGPART end;
```

(1d)

```
function CSUM ( X,Y : COMPLEX): COMPLEX;
  begin
        CSUM := MAKECOMP (RE(X) + RE(Y), IM(X) + IM(Y))
  end;
```

(1e)

```
function CEQUALS ( X,Y: COMPLEX ): Boolean;
  begin
        CEQUALS := RE(X) = RE(Y) & IM(X) = IM(Y)
  end;
```

(1f)

```
type COMPNUM =
  record
        REALPART, IMAGPART: real;
        TEMPORARY: Boolean
  end;
```

(1g)

```
function MAKECOMP (R, I: real): COMPLEX;
  var P: COMPLEX;
  begin NEW(P);
        P@.REALPART   := R;
        P@.IMAGPART   := I;
        P@.TEMPORARY: = TRUE;
        MAKECOMP      := P
  end;
```

We can use pointers advantageously in creating our package for complex numbers. Instead of using the type COMPLEX to name our complex-number record, let us rename that record COMPNUM and use COMPLEX to refer to a pointer to a COMPNUM, as shown in listing 1a. Declaring variables as in:

var A, B, C, D, E, F : COMPLEX

does not create six records—only six pointers. The records come into being later.

We can give a calling program an easy way to create a complex number by noticing that the Pascal predeclared function NEW can be used to create instances of a type at execution time. A call such as NEW(P), where P is a pointer to some type, creates space for an instance of that type, returning the location of the new instance in P. We can now write a Pascal function MAKECOMP, as in listing 1b.

MAKECOMP creates a new complex number with real and imaginary parts and returns a pointer to that new number as its value. A user can then write:

A := MAKECOMP(2.0, −5.5)

and, assuming that A is of type COMPLEX, never realize what is going on at the lower level.

We can further insulate the user from the "dot" notation of Pascal records and any concern with pointers by writing two functions that access the real and imaginary components (see listing 1c). Given that Y is of type real, Y := RE(A) looks much like the corresponding notation from mathematics.

At this point, we can start writing other functions to do complex arithmetic. All such functions can now be written with arguments and return values of type COMPLEX, and no further reference must ever be made to lower-level implementation details. For example, see the code for CSUM in listing 1d. A function to determine if two complex numbers are equal might be written as in listing 1e.

Giving Back the Memory

This would all work very well, except for one problem. If we were to write the complex-expression equivalent of:

$$E = (A \times B) + (C \times D)$$

[E:= CSUM(CPROD(A,B),CPROD(C,D))]

our scheme would call NEW to get space for the *temporary* results CPROD(A,B) and CPROD(C,D), as well as for the final sum of the two. What happens to the two temporary records we created?

They remain allocated and will not be reused. Continual use of expressions like this will allocate temporary space that will not be recovered. Eventually, our program will run out of dynamic-memory space (usually called *heap* space) and "bomb," even though we're not actually using all that space.

(1h)

```
procedure CASSIGN (var C1, C2: COMPLEX);
  begin
        if C1 < > nil then DISPOSE(C1);
          (* if C1 already points to something *)
          C1 := MAKECOMP(RE(C2), IM(C2));
          C1@.TEMPORARY := FALSE
  end;
procedure CRELEASE (C1: COMPLEX);
  begin
        if C1@.TEMPORARY then DISPOSE(C1)
  end;
```

(1i)

```
function CSUM(X,Y: COMPLEX): COMPLEX;
  begin
        CSUM := MAKECOMP(RE(X) + RE(Y), IM(X) + IM(Y));
        CRELEASE(X); CRELEASE(Y)
  end;
```

Pascal, in most reasonable implementations, has a built-in function DISPOSE(P) that, given a pointer P, returns whatever is pointed to by P to the heap. It's the inverse of NEW. The problem is for our system to be able to discern whether a given complex is temporary, as in the intermediate expressions above, or permanent, like A, B, C, D, and E.

One way to do this is to add to each record a Boolean field TEMPORARY that is set to TRUE by MAKECOMP. This changes the declaration of COMPNUM to that shown in listing 1f. It also changes the MAKECOMP function to that shown in listing 1g. Two questions remain: how to designate permanent complex numbers, and how to DISPOSE of temporary ones.

The first question is answered by noticing that the only time we need a permanent complex number is when we are assigning it to a declared variable. To do this, we write a procedure CASSIGN(C1, C2), which copies C2 into C1, replacing the assignment (:=) operation and setting TEMPORARY to false.

To dispose of temporary structures, we can write a procedure CRELEASE(C) that calls DISPOSE if C is temporary. We have to call CRELEASE in each of our arithmetic functions so input arguments to these functions can be given back, if temporary. The CASSIGN and CRELEASE procedures are seen in listing 1h.

This may be messy. But since Pascal will not "collect the garbage" automatically, it's about the only way to reclaim the storage. As an example of where to use CRELEASE, consider the revised CSUM in listing 1i. A typical assignment statement might be:

CASSIGN(A, CSUM(B, CPROD(C,D)))

which is equivalent to $A = B + C \times D$.

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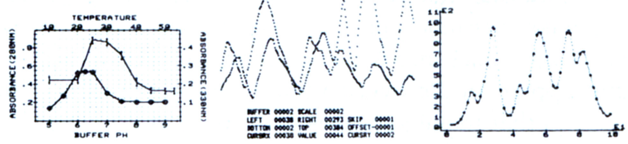

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good implementation strategy (pointers and records) and the right low-level primitive functions (MAKECOMP, RE, IM) has given us a healthy level of insulation for higher-level programs from messy details. Even fundamental operations like sum and equals can be written using the notations of the application area, rather than the esoterica of the programming language.

An objection could be made that we are paying a price in run-time efficiency by insisting on all these levels of insulation, each imposing either a subprogram call (and its overhead) or an indirect (pointer) reference (also with an associated overhead). There is no doubt that a price measured in machine performance is exacted here. We counter by pointing out that almost any device used in programming to increase *people* efficiency (and this includes high-level languages) takes its toll in reduced machine performance. In today's world of fast and inexpensive hardware, it's a price worth paying.

The Specification Part

The routines shown previously constitute part of what is usually called the *package body*, namely, the implementing code for all the routines. Ideally, we should be able to write a section giving only functional specifications, and this would be the only part visible to a user or calling program.

Listing 2: *The specification part of a* package *that states the complex-number data type. It is included in the Pascal program as a comment and explains what the attributes of the package are, but not necessarily how they work.*

```
(* package ComplexNumbers
   type COMPLEX                                    details private
   function MAKECOMP ( R,I : real )                    : COMPLEX;
   function RE ( C : COMPLEX )                         : real;
   function IM ( C : COMPLEX )                         : real;
   function CSUM ( X,Y : COMPLEX )                     : COMPLEX;
   function CDIFF ( X,Y : COMPLEX )                    : COMPLEX;
   function CPROD ( X,Y : COMPLEX )                    : COMPLEX;
   function CQUOT ( X,Y : COMPLEX )                    : COMPLEX;
   function CEQUALS ( X,Y : COMPLEX )                  : Boolean;
   function CLESSEQ ( X,Y : COMPLEX )                  : Boolean;
   function CGTREQ ( X,Y : COMPLEX )                   : Boolean;
   ...and possibly some complex I/O routines. *)
```

Listing 3: *A complex-number package written for the Pascal-like language Ada.*

```
function "*" (x,y: complex) return complex is
   R,I: float;
   begin
         R := RE(x)*RE(y) - IM(x)*IM(y);
         I := RE(x)*IM(y) + IM(x)*RE(y);
         return (R,I);
   end;
function "*" (x: float; y: complex) return complex is
   TEMP : complex;
   begin
         TEMP := (x * RE(y), x * IM(y));
         return TEMP;
   end;
```

Since Pascal has no facility for separating these two important sections, we shall write the specification part as a block comment. A specification part for complex numbers is shown in listing 2.

Operator Overloading

In writing our complex-number package in Pascal, we were forced to use prefix-function notation (ie: CSUM(X,Y), and so on). Ideally, a higher-level program should be able to write $X + Y$ when $X + Y$ is meant, and the compiler should be able to invoke the addition routine appropriate to the declared types of X and Y. Suppose, for example, that X and Y were vectors of integers. If we had written a routine to add two vectors, there ought to be some way to inform the compiler that vector addition is what is meant by $X + Y$ if X and Y are declared as vectors. In other words, instead of calling our complex-addition routine CSUM, we should be able to call it +, and let the compiler determine when its use is appropriate.

To give an example of how this *can* be done in Ada, here are two functions, both called *, to do complex multiplication and multiplication of a complex by a real scalar (see listing 3).

The two most important parts of this example are the two additional operators named *—the compiler can tell which one is meant, in an expression, by the types of the operands—and the fact that in Ada, unlike Pascal, structures can be returned as function values. The pointer scheme used in this article is thus unnecessary in Ada.

This technique of adding power to an arithmetic operation, extending its range to cover new data types, is known as *operator overloading*. Several experimental languages have supported overloading; SNOBOL4 is a major language in the "real world" that has supported it for more than ten years. But no widely used procedural language permits operator overloading. As the Ada language comes into wide use, many people will discover and appreciate its overloading facility, as well as other niceties that make packages easy to do.■

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A Voice for the Apple II Without Extra Hardware

Robert A Payne
7437 Arizona Ave
Los Angeles CA 90045

With an Apple II computer and a standard cassette-tape player, I have been able to store human voices in digital form and recall them later with relatively good fidelity. In fact, my 48 K-byte Apple computer can store up to three minutes of digital voice data without additional hardware or disk storage.

My experiments in this area began after reading other articles concerning the application of home computers to voice recording (see reference). These prompted me to try simple hardware additions to a standard Apple computer and to experiment with various low-priced A/D (analog-to-digital) converters that were readily available from local electronics supply houses.

The problems I encountered fell into three general categories: first, most inexpensive A/D converters will not operate in the range of 10,000 to 12,000 samples per second. This is the minimum rate acceptable for reasonable word reproduction. Second, at higher sample rates the computer memory required to store the digital data exceeds the memory of the Apple computer after only a few seconds of actual operation. And finally, the hardware I was adding to the computer tended to be cumbersome and of relatively low quality. I would have to overcome each of these problems before I could store voices in my computer.

Recording the Voice

The idea for recording voice without additional hardware came from looking at commercially available software that digitizes voice input to the Apple computer from a standard cassette-tape recorder through the cassette-input port. It is possible to monitor zero crossings of any analog signal, including voice, simply by making a recording of the signal on a cassette tape, then plugging the recorder into the Apple cassette-input port and playing the tape back while monitoring memory location C060 (hexadecimal), bit 7 (cassette input). Above a certain level of input signal, the cassette input will read high; below this level it will read low. The level of this transition is called the *threshold*.

If voice is thought of as being a simple sinusoidal function, it is readily apparent that each time the signal crosses the threshold, the state of the cassette-input bit changes. A history of these changes contains all of the frequency characteristics of the original analog input, assuming two threshold crossings per cycle. Since this method of data gathering really amounts to a 1-bit A/D conversion, amplitude information is not present and the stored voice will be reproduced at a constant volume depending on the hardware used for the actual playback.

It should also be noted at this time that the sampling rate must meet the Nyquist criteria. That is, the rate at which the cassette-input port is read must be equal to at least twice the frequency of the highest voice harmonic that we wish to store.

The ideal cassette recorder should have a volume and a tone control so that the user can input the correct amplitude and control the frequency range to reproduce a given voice with minimal noise and to cause the midpoint of the input signal's peak-to-peak amplitude to be set at the point where the Apple threshold ("0" to "1" transition) occurs. The quality of speech recorded will vary dramatically with changes in these parameters, and each individual will have to find the correct settings by experimentation. For my own voice and cassette recorder, I use relatively low volume settings with the tone control adjusted to its highest frequency.

Data Compression

At this point, by using the cassette input for data, I had solved the problems of not being able to find inexpensive A/D converters that could sample at a fast enough rate to record voice and of having to add wires and power supplies to my Apple computer. However, once I learned how to record voice and store it in memory, I found that about twenty seconds of data were all I could handle. This was the result of packing 8 bits of A/D data into each memory location.

On close inspection I found that the data that had been stored did not always change from sample to sample. This was true when low-frequency signals were being input and also during the times when no input was being sensed at the cassette-input port (eg: when the speaker stops to breathe, or at the beginning of a recording before the speaker has started talking). Since the data fluctuations had this characteristic, I decided to store data such that the first bit of each memory location represented the status of the A/D input and the next 7 bits represented a counter indicating the number of samples collected while that input remained unchanged. If the counter overflowed the alloted 7 bits, the same A/D bit would be stored in the next memory location with a new counter value.

Listing 1 is written in 6502 machine language and should load voice data into any Apple computer with 48 K bytes of memory. For machines with less memory, the operands in statements 849 and 810 (hexadecimal) can be changed to a smaller hexadecimal number representing the most-significant byte of the upper limit of memory.

At this point I had a computer memory full of A/D data that contained enough samples to reproduce between one and three minutes of reasonably understandable human voice. The exact time of playback is a function of voice pitch and the setting of the inputs on the tape recorder. Also, certain sounds such as "sssss" tend to cause a great deal of change in the A/D data relative to the sampling rate and will therefore give less voice recording time for a given amount of memory.

Although it is difficult to analyze the efficiency of this new A/D packing technique by data inspection, I assume that it is five to six times more efficient than the method of packing 8 bits per word. I base this conclusion on the improvement in time for a given memory size. Reproducing the voice data for playback was the next logical experimental step.

Reproducing the Voice

The Apple computer has an on-board speaker that can be toggled by a read or a write to memory location C030 (hexadecimal). The software shown in listing 2 will unpack the stored A/D data and toggle the speaker each time that the data counter reaches zero and the A/D bit changes state. This amounts to producing a "click" on the output speaker each time the original input voice signal had a zero crossing.

Listing 1: *A/D input routine. Record your voice input on the cassette tape, then run the tape while executing this program starting at location 800 (800G). Voice data will be stored from location 1000 through BFFF in the form of data plus counter. Adjust the number at location 81F to change the sample rate of the A/D converter. The lower the number, the better the quality, but less time will be available for a given amount of memory.*

```
800  A9 00     LDA #$00
802  8D 00 10  STA $1000     Store zero
805  EE 03 08  INC $0803     Increment storage LSB
808  D0 F8     BNE $0802
80A  EE 04 08  INC $0804     Increment storage MSB
80D  AD 04 08  LDA $0804
810  C9 C0     CMP #$C0      Check for end of memory
812  D0 EC     BNE $0800
814  A9 00     LDA #$00      Restore storage LSBs and MSBs
816  8D 03 08  STA $0803
819  A9 10     LDA #$10
81B  8D 04 08  STA $0804
81E  A0 0A     LDY #$0A      Load sample rate delay counter
820  88        DEY
821  D0 FD     BNE $0820
823  AD 60 C0  LDA $C060     Get data from cassette input port
826  29 80     AND #$80      Use only the first bit
828  CD A0 09  CMP $09A0     Compare to previous A/D sample
82B  8D A0 09  STA $09A0     Replace old A/D value with new one
82E  D0 05     BNE $0835     Branch if bit changed state
830  E8        INX           Increment counter
831  E0 7F     CPX #$7F      Compare counter to overflow value
833  D0 E9     BNE $081E     Branch if counter < 127
835  8A        TXA           Move counter to accumulator
836  A2 00     LDX #$00      Zero counter
838  4D A0 09  EOR $09A0     OR bit with counter value
83B  8D 00 10  STA $1000     Store data plus counter
83E  EE 3C 08  INC $083C     Increment storage location
841  D0 DB     BNE $081E
843  EE 3D 08  INC $083D
846  AD 3D 08  LDA $083D
849  C9 C0     CMP #$C0      Check for end of memory
84B  D0 D1     BNE $081E
84D  A9 00     LDA #$00      Restore program locations
84F  8D 3C 08  STA $083C
852  A9 10     LDA #$10
854  8D 3D 08  STA $083D
857  00        BRK           End of storage routine
```

It may be hard to imagine how these clicks can reconstruct the human voice since they have no tones or amplitudes related to the original voice input. Try not to think about the individual clicks; instead, think of a series of clicks being output at a varying frequency which is a function of the original voice input. This varying frequency is an FM (frequency modulated) reproduction of that original input signal.

Although the reproduced signal is understandable if output in the above manner, there are several significant sources of noise that degrade the voice, one being the Apple's on-board speaker itself. The others relate to the method of sampling and reproducing the data. To reproduce any analog signal stored in digital format, it is very important to sample the A/D converter at a constant rate and to make the corresponding D/A (digital-to-analog) conversion at that same uniform rate. Any variance of these rates will cause high noise levels that will have to be filtered.

Unfortunately, the software that I had written to sample the input data had several different logical paths to follow depending on whether the counter was being incremented or whether it plus the data bit were being stored, and whether the least- or most-significant bit of the storage location had to be incremented. Each case took a different number of machine cycles to complete and therefore affected the time required to return and read the cassette-input port. When I modified the software to make each logical path use the same number of machine cycles, what I was really doing was slowing down each logical loop until they all ran at the rate of the slowest loop. This had the undesired effect of lowering the sample rate and reducing the bandwidth of the input signal, which attenuated the higher harmonics to the point where word recognition became extremely difficult.

Two solutions to the above problem were possible: the first was to use digital-filtering techniques on the stored data to remove unwanted noise. I rejected this due to the complexity of designing a bandpass filter which is not symmetrical with respect to a frequency equal to one half of the A/D sampling rate. The design of this type of filter requires the use of complex multiplying coefficients and is not practical for real-time microcomputer operations on large amounts of data.

Instead, I used the hardware filters controlled by the cassette-tape-recorder tone control and sent the data back to the cassette to be either recorded on tape or output in the PA (public address) mode. To do this I changed the output software to toggle memory location C020 (cassette output) instead of the Apple speaker. The results were quite good when using this method to reproduce the stored voice. I used the cassette tone control to filter out unwanted noise.

Just to prove that anyone can understand a voice that had been recorded and then reproduced with the methods I have discussed in this article, I tried recording random passages from several different textbooks and playing them back to different listeners. Most had no trouble understanding the output once I had optimized the sampling rates and tone controls for my own voice.

Future Plans

The next step in my experiments will be to store digitized voice on the computer disk, which should allow approximately ten minutes of playback. I am also trying to find methods of packing voice data into more efficient patterns to minimize memory-size requirements. I hope this article helps others find inexpensive methods of bringing speech to their computers.■

Reference

Anderson, James C. "An Extremely Low-Cost Computer Voice Response System," February 1981 BYTE, pages 36-43.

Listing 2: *A/D output routine. First store data using listing 1 and a cassette recorder. After the data is stored in the Apple memory, it can be output to the on-board speaker by running this program from location 860 (860G). To send the data back to the cassette-output port, change location 874 to 20 and run the program from location 860 with the tape recorder in either the record or PA mode. The counter in location 877 should be adjusted until the optimal output is found. The number at location 892 is the most-significant byte of the upper limit of memory.*

```
860   AD 01 10   LDA $1001        Get A/D data
863   29 7F      AND #$7F         Mask for counter only
865   AA         TAX              Move counter to X register
866   AD 01 10   LDA $1001        Get A/D data
869   29 80      AND #$80         Mask for data only
86B   CD A0 09   CMP $09A0        Compare to previous data
86E   8D A0 09   STA $09A0        Store current data
871   F0 03      BEQ $0876        Branch if current data = last data
873   8D 30 C0   STA $C030        Toggle output
876   A0 0D      LDY #$0D         Programable delay loop
878   88         DEY
879   D0 FD      BNE $0878
87B   CA         DEX              Decrement A/D counter
87C   30 02      BMI $0880        Used only for initial value of zero
87E   D0 F6      BNE $0876        Branch if A/D counter <> 0
880   EE 61 08   INC $0861        Increment data pointer's LSBs
883   EE 67 08   INC $0867
886   D0 D8      BNE $0860        Test for MSB increment
888   EE 62 08   INC $0862        Increment data pointer's MSBs
88B   EE 68 08   INC $0868
88E   AD 68 08   LDA $0868
891   C9 C0      CMP #$C0         Test for the end of memory
893   D0 CB      BNE $0860        Branch to next sample
895   A9 01      LDA #$01         Restore pointers
897   8D 61 08   STA $0861
89A   8D 67 08   STA $0867
89D   A9 10      LDA #$10
89F   8D 62 08   STA $0862
8A2   8D 68 08   STA $0868
8A5   00         BRK
```

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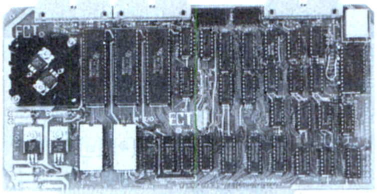

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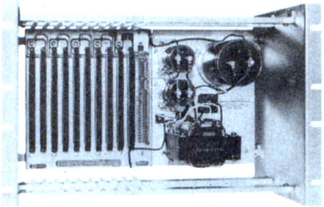

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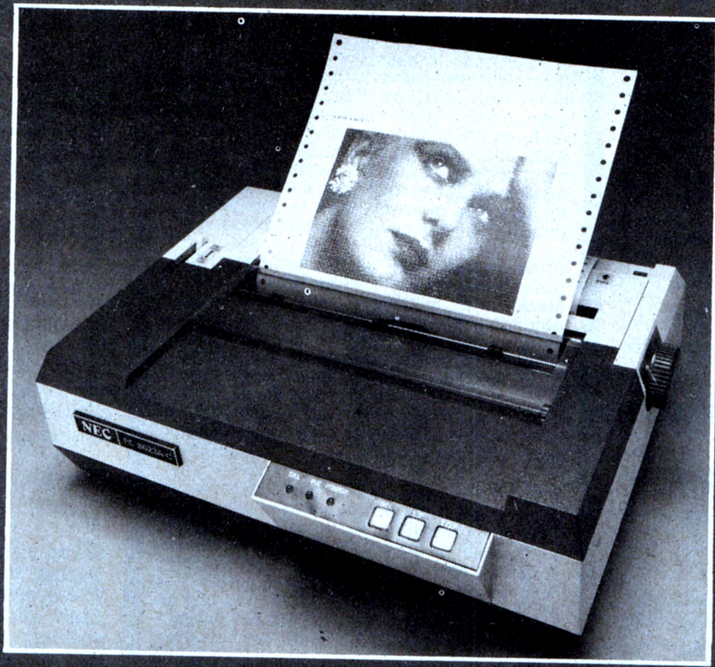

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by David Stambaugh

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Circle 251 on inquiry card.

PERIPHERALS

BYTEWRITER

Computer-Driven Typewriter

The Bytewriter operates as a letter-quality printer and as an office typewriter without any attachments. The self-contained mechanism uses electromagnetic actuators to interrupt the motion of a set of levers driven by a Smith-Corona 8000 office typewriter's motor. A microprocessor controls the operation of the Bytewriter and provides an automatic self-test.

The Bytewriter costs $795. For more information, contact Bytewriter, 125 Northview Rd, Ithaca NY 14850, (607) 272-1132.

Circle 501 on inquiry card.

Silentype Thermal Printer

The Silentype thermal printer offers 80-column, draft-quality copy and the ability to print high-resolution graphics. The Silentype can be used with Apple II, II Plus, and III microcomputers. It prints upper- and lowercase text at up to 40 cps (characters per second). Graphics characters are printed at 60 dots per inch. Standard heat-sensitive paper is used instead of aluminized rolls. With the Apple III, type styles can be specified.

The Silentype printer costs $395. For more information, contact Apple Computer Inc, 10260 Bandley Dr, Cupertino CA 95014, (408) 996-1010.

Circle 502 on inquiry card.

IBM or Apple?

The Apple II will soon have available for it an 8088 microprocessor card that will enable it to run software for the 8088/86 family. The 8088 is the same microprocessor used in the new IBM Personal Computer. The MetaCard is a secondary processor card featuring a 5 MHz 8088; 64 K bytes of programmable memory with parity checking, expandable to 128 K; 2 K bytes of ROM (read-only memory), expandable to 8 K; an external bus connector for expansion to 384 K bytes of memory; a real-time clock interrupt for multitasking; provisions for 8087 floating-point support; full-speed concurrent processing by both the 8088 and the Apple's 6502; interrupts in both directions between processors; and access to the Apple's memory by both processors. In most applications when the MetaCard is active, the 6502 will be used as an I/O (input/output) processor.

For software, CP/M-86 will be included. MP/M-86 and UCSD Pascal 4.0 will also be offered for multitasking purposes. The MetaCard can directly address up to one half megabyte of memory. Software that will run under CP/M-86 will run on the MetaCard including software for the IBM Personal Computer. The price for the MetaCard, which will occupy one of the Apple slots, is $980. Contact Metamorphic Microsystems, POB 1541, Boulder CO 80306, (303) 499-6502. Circle 503 on inquiry card.

TRS-80 Model III Light Pen

The 3G Light Pen lets you bypass the TRS-80 Model III's keyboard and act directly on the information on the video display. It is fully assembled and comes with a demonstration game cassette, sample program, and manual. The pen sells for $39.95 and is available from 3G Company Inc, Rt 3, Box 28A, Gaston OR 97119, (503) 662-4492.

Circle 577 on inquiry card.

Inexpensive Modem

The Model 1080 VersaModem offers the ability to converse with information utilities such as The Source, CompuServe, Dow Jones, computerized bulletin boards, and university computers. The direct-connect VersaModem operates at 300 bps (bits per second) using Bell standard 103 protocol and connects to your terminal or computer through an RS-232C serial port. The VersaModem costs $119. For details, contact Bizcomp Corporation, POB 7498, Menlo Park CA 94025, (415) 966-1545.

Circle 504 on inquiry card.

Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first-in first-out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

What's New?

PERIPHERALS

Tractor-Feed Conversion

The Model 16 Fanfold Feeder allows continuous-form paper to be used with IBM Selectrics and other typewriters or printers. It maintains continuous-form alignment, installs easily, and requires no electrical or mechanical connections. The adjustable-width tractors accept form widths of up to 16½ inches and can be used with single- or multiple-part forms. The price for the Model 16 Fanfold Feeder is $149.95. Contact McAnn Company, POB 3173, San Mateo CA 94403, (415) 349-1229.

Circle 505 on inquiry card.

12-Inch Green-Phosphor Monitor

The Video-300 monitor features a 12-inch screen, 18 MHz bandwidth, and a resolution of 1000 scan lines at the center and 800 at the corner. Its green-phosphor display cuts down annoying reflection and glare. The monitor weighs 17 pounds and measures 29 by 37 by 34 cm (11⅗ by 14½ by 13⅖ inches). The suggested retail price for the Video-300 monitor is $249 from Amdek Corporation, 2420 E Oakton St, Suite E, Arlington Heights IL 60005, (312) 364-1180. Amdek was formerly known as Leedex Corporation.

Circle 507 on inquiry card.

Expand the TRS-80

The MDX-1 and -2 expansion interface boards are hardware- and software-compatible with the TRS-80 Model I computer. They feature 32 K bytes of memory expansion, provisions for a 2 K- or 4 K-byte EPROM (erasable programmable read-only memory), a direct-connect, 300-bit-per-second modem, a serial port, a parallel port, a dual-cassette option, and hardware for a real-time clock. The MDX-2 also has a floppy-disk controller. The MDX-2 bare board costs $74.95, and the MDX-1 costs $64.95. Manuals are $5.95. Parts kits and cabinets are available. Contact Micro-Design, POB 748, Manchaca TX 78652, (512) 282-0225.

Circle 509 on inquiry card.

TRS-80 Telecommunications

The Connection offers telecommunications capabilities on Model I TRS-80s with or without an expansion interface. This direct-connect modem eliminates noise and data loss or distortion. The unit features an RS-232C I/O (input/output) port and runs at 300 bps (bits per second) in duplex or simplex modes. It can be connected to two-way radios and can provide computer-to-computer communications over the air. Software, documentation, a list of on-line bulletin boards, and operating procedures are included with the Connection. It is available for $249 from the Microperipheral Corporation, 2643 151st Pl NE, Redmond WA 98052, (206) 881-7544.

Circle 506 on inquiry card.

1200 BPS Direct-Connect Modem

The CM2020 is a 1200-bit-per-second single-card modem that saves valuable workspace because it measures only 30 square inches. Using a microprocessor-based design, auto-dialing, self-testing, and auto-answering are made available on the modem. Other features include self-testing or testing via the terminal, frequency-sensitive carrier-detect circuitry that will not trigger data-carrier detect unless there is true in-band carrier energy present, Bell 202S-compatibility, and selectable call origination that supports auto-dialing, dial-through, and conventional dialing. The CM2020 modem costs $200, in 50-unit lots. For details, contact Intertel, 6 Shattuck Rd, Andover MA 01810, (617) 681-0600.

Circle 508 on inquiry card.

Epson MX-100

The 136-column MX-100 dot-matrix printer uses matrices that range from 9 by 9 to 18 by 18 dots. It can print 12 different character weights and sizes. The printer also features Epson's disposable print head and GRAFTRAX, a high-resolution bit-image graphics capability. Using paper 15½ inches wide, the MX-100 can print up to 233 columns in the condensed-print mode. Bidirectional printing at 80 cps (characters per second) can be accomplished by using its logic-seeking function.

The printer comes with a friction paper feed and adjustable tractors on a removable tractor mechanism. The suggested retail price for the MX-100 is $995. For details, contact Epson America Inc, 23844 Hawthorne Blvd, Torrance CA 90505, (213) 378-2220.

Circle 510 on inquiry card.

What's New?

PERIPHERALS

High-Resolution Light Pen for the Apple

The LPS II light pen makes use of the Apple II's 280- by 192-pixel resolution. Applications such as computer-aided design, menu selection, graphics, circuit analysis, word processing, and game playing can benefit from the LPS II. It is compatible with all available languages. It works at a 60 Hz rate, which allows true animation and drawing. When the video beam passes on the screen, the LPS II uses video-synchronization information to determine the pen's location. The LPS II is available for $285 from Gibson Laboratories, Bldg 10, 406 Orange Blossom, Irvine CA 92714, (714) 559-8727.

Circle 511 on inquiry card.

Housing for Disk Drives and Video Display

The Super Card Cage V1 includes a four-slot Multibus motherboard and space for mounting two 8-inch floppy-disk drives, a video monitor, a switching power supply, and a separate keyboard enclosure. The unit is predrilled for a fan, connectors, fuse, power cord, and power switch. Optional configurations accommodate up to six Multibus cards or a six-slot S-100 bus, an eight-slot Q-BUS, or twelve-slot STD-BUS motherboards. The Super Card Cage V1 costs $495. Contact Psytek Inc, 1900 Pickwick Ave, Glenview IL 60025, (312) 729-3200.

Circle 513 on inquiry card.

Tractor-to-Friction-Feed Conversion

The Paper Tractor enables a tractor-feed printer to print with single-sheet paper. The device is made of sheet plastic into which standard or letterhead paper is inserted. The Paper Tractor is then fed into the tractor-feed printer, where it carries the paper into the print area. It can be used on front-, back-, and dual-tractor-feed printers and with Epson, Paper Tiger, GP-80M, and other popular printers. The device sells for $19.50 and is available from Paper Tractor, POB 4218, Santa Barbara CA 93103, (800) 235-6967; in California (805) 966-5448.

Circle 515 on inquiry card.

2-Megabyte 5-Inch Floppy-Disk Drives

The Megafloppy 1117 family of floppy-disk drives offers up to 2 megabytes of storage in a single 5-inch drive. There are two single- and two double-sided drives using 96- or 100-track-per-inch double-track technologies in this family of floppy-disk drives. Data-recording density is 12,000 bits per inch. The 1117 provides 6 ms track-to-track positioning speed with transfer rates of 600,000 bps (bits per second). The drives are compatible with industry-standard interfaces, mounting dimensions, and bezels. Double-sided models provide 2.175 and 2.025 megabytes of formatted storage, and single-sided versions offer 1.2 and 1.1125 megabytes. For pricing and availability, contact Micropolis Corporation, 21329 Nordhoff St, Chatsworth CA 91311, (213) 709-3300.

Circle 512 on inquiry card.

Plug-A-Bubble

The Plug-A-Bubble system features removable bubble-memory cassettes designed for harsh environments or critical data-storage applications. The system consists of a 128 K-byte bubble-memory cassette and holder. A chassis, containing two holders and an interface card, fits in the same space as a 5-inch floppy-disk drive. The cassette and holder can be designed to interface with any system.

Each Plug-A-Bubble cassette has a 48 ms average access time and requires +5 and +12 V at 8 W for operation. Also available is a development kit that includes the bubble circuits, a prototyping board, and instructions for designing bubble systems. For information about memory-system products, contact Intel Corporation, 1302 N Mathilda Ave, Sunnyvale CA 94086, (800) 538-1876; in California (408) 734-8102.

Circle 514 on inquiry card.

Graphics and Photography System

The Professional Graphics System can generate graphics on large-screen televisions. Also, it can perform video titling and graphics on tape or simulate a General Electric Genegraphics system for the production of 4- by 5-inch transparencies, 35 mm slides, or Polaroid prints using the screen printer from Image Resource Corporation of Palo Alto, California. Professional Graphics can transfer any display from an Apple II's high-resolution screen and output it as full NTSC (National Television Standard Code) video with interlace and meet SEMPTE (a time code broadcasting standard) criteria.

The Professional Graphics System runs on a 48 K-byte Apple II or Apple II Plus, with a disk drive. It costs $2950. Contact Symtec, 15933 W Eight Mile Rd, Detroit MI 48235, (313) 272-2950.

Circle 516 on inquiry card.

What's New?

SOFTWARE

More FORTH

Nautilus Systems is marketing a cross-compiler progam for FORTH. It automatically forward references any word or label. It can produce headerless code and ROMable (read-only memory) code with initialized variables. This cross-compiler has a load map as well as a full list of undefined symbols.

Machine-readable versions of the cross-compiler program are available for CP/M, TRS-80 Model I, Heath H-89, and North Star computers. Each includes an executable version of fig-FORTH 1.0, the cross-compiler source code, and documentation. The price for the program is $200 from Nautilus Systems, POB 1098, Santa Cruz CA 95061, (408) 475-7461.

Circle 517 on inquiry card.

VT-100 Terminal Emulator Program

ABT VT-100 is a Pascal program that uses the Videx 80-column card and the Apple communications card to emulate a Digital Equipment Corporation VT-100 terminal. It recognizes all the ANSI (American National Standards Institute) and VT-52 escape sequences. When used with Apple Pascal, this program can transmit Pascal text files from the Apple to another computer. Not all of the VT-100 features are offered.

The ABT VT-100 program costs $495. For more information, contact Advanced Business Technology Inc, 12333 Saratoga-Sunnyvale Rd, Saratoga CA 95070, (408) 446-2013.

Circle 519 on inquiry card.

Custom-Design Your Own Character Sets

The Code Works has two programs to help Atari users design their own character sets. With the Fontedit program, users can create the Russian alphabet, APL characters, or special-purpose graphics symbols. Together with Fontedit, the Knotwork program assists users in designing patterns of Celtic Interlace, a technique used by seventh-century Irish monks to illustrate manuscripts. Both programs run on Atari microcomputers. They are available together for $15.95 on cassette or $18.95 on disk. Contact the Code Works, POB 550, Goleta CA 93116, (805) 683-1585.

Circle 521 on inquiry card.

Software for the TRS-80 Voice Synthesizer

SAYIT is a program for TRS-80 Model I Level II computers with or without disk drives. SAYIT allows the Radio Shack Voice Synthesizer to add voice output to BASIC programs. SAYIT adds a SAY command to BASIC that makes the synthesizer speak string or numeric expressions or a combination of the two. Arithmetic expressions are also correctly verbalized. Phonetic spelling can be used to make difficult words intelligible. A talking keyboard feature echoes each key struck and can be switched on or off from BASIC. The program can also be used in experiments using the International Phonetic Alphabet and phonetic strings. SAYIT costs $125, including a manual. Contact Baysik Speech, Suite 289, 1259 El Camino Real, Menlo Park CA 94025.

Circle 518 on inquiry card.

WordStar for Z-89

The WordStar word-processing program is now available for the Zenith Model Z-89 microcomputers. WordStar allows users to print and edit simultaneously and has a tab feature that automatically lines up decimal points in columns. A hyphen-help feature asks users whether to insert a hyphen at the end of certain lines. Boldface, double strike, strikeout, subscript, superscript, overprint, and accent entry commands are also included. WordStar can interrupt itself, execute another program, and return. It will run on CP/M-based Z-89 or Heath H-89 computers with 48 K bytes of memory, but the simultaneous printing and editing feature requires 64 K bytes. The price for WordStar is $395. Contact your Heath/Zenith dealer or write Zenith Data Systems, 1000 Milwaukee Ave, Glenview IL 60025, (312) 391-8181.

Circle 520 on inquiry card.

Electronic Mail for Apple Users

Micro-Courier allows Apple II owners to transmit data to other computers over telephone lines. Transmissions can be sent automatically at a cost of less than $0.25 for 1000 words of text. The system also maintains telephone lists and sorts messages by individual users. Micro-Courier costs $250.

Micro-Telegram allows Apple users to access Western Union services and to send and receive teletypewriter exchange, Telex, and international cables. Apple users can access stock, foreign exchange, gold, and futures information, as well as sports reports and ski conditions from the Western Union data base. Micro-Telegram costs $250. For more details, contact Microcom, 89 State St, Boston MA 02109, (617) 367-6362.

Circle 522 on inquiry card.

What's New?

SOFTWARE

The Micro Link

The Micro Link program lets computer users communicate with each other over telephone lines. Files can be prepared in advance and transmitted automatically. The program features a word-wrapped display fitted to any screen width. The Micro Link can scan The Source, data bases, and computerized bulletin-board systems and record segments of the displays. The Micro Link can serve as a host for another computer or a terminal, so it only needs to be present at one end. The program supports originate and answer modes, full- and half-duplex, and operates at standard data rates. Files can be transmitted in character-, line-, or memory-block protocol. To run, Micro Link needs a Z80- or 8080-based computer with a serial port and modem, 16 K bytes of programmable memory, and the Micropolis disk operating system or CP/M 1.4. The program comes on 16-sector, 5- or 8-inch disks. The price is $89 from Wordcraft, c/o Microcomputer Software Associates, 1122 B St, Hayward CA 94541, (415) 534-2212.

Circle 523 on inquiry card.

FORTH for OSI

S-FORTH is a full implementation of fig-FORTH that runs on all Ohio Scientific (OSI) disk-based computers, from the C1P to the C3. It includes an editor, a virtual-memory disk subsystem, and compatibility with OS65D commands.

S-FORTH is available on either 5- or 8-inch floppy disks for $34.95 or for $49.95 including the source listing. Contact Aurora Software Associates, POB 99553, Cleveland OH 44199, (216) 221-6981.

Circle 524 on inquiry card.

Program for Property Brokers

The Income Property Analysis System (IPAS) is a system of programs for investors, syndicators, and brokers of income properties. With IPAS, the before- and after-tax cash flows of income properties can be analyzed. Provisions are made for handling multiple notes with straight or negative amortization, interest-only notes, or wraparound notes. The program can also be used to analyze rates of return for income property that is already owned. A separate program allows the investor to project after-tax rates of return for up to 10 years, using individual inflation rates for income, expenses, and appreciation of the property value.

The IPAS runs on a TRS-80 Model I or Model III with at least one disk drive and 32 K bytes of memory. The price is $225. A manual can be purchased separately for $5. For details, contact Advanced Business Microsystems, 5801 Marvin D Love Fwy, Suite 103, Dallas TX 75237, (214) 339-2109.

Circle 525 on inquiry card.

Automatic Graphing of Functions

Automatic Graphing of Functions lets users graph equations in the form $y = mx + b$ and $y = f(x)$. It can graph formulas, multiple equations, summation, sine, cosine, and more. The axis is automatically scaled for the size of the screen display. The program has manual or automatic range selection. It is available for the TRS-80 Model I Level II and the Model III. The cassette and manual cost $19.95 from David L Modney, 4144 N Via Villas, Tucson AZ 85719.

Circle 526 on inquiry card.

Telecommunications for the AIM-65

The MDA 2.2 program allows the AIM-65 to function as a full-duplex terminal for communication with a timesharing system or host computer. Utilities are provided for saving and loading BASIC programs or object files through the terminal simulator at speeds up to 2400 bps (bits per second). MDA 2.2 is available in EPROM (erasable programmable read-only memory) along with a source-code listing and manual for $50. Contact Thorson Engineering Company, 6225 76th St S E, Snohomish WA 98290, (206) 334-4214.

Circle 527 on inquiry card.

Dial-Up Software for Your Apple

Online will allow you to call your computer while you're away from home or let your computer take messages in the form of a private message system. It requires a 48 K-byte Apple II Plus with the Hayes Micromodem and at least one disk drive. Up to 50 user accounts, which require an account number and a password for log-in, can be set up. A guest account can also be arranged. Each account can be assigned different priority levels that determine which features or areas of the system may be accessed by that account. This makes Online useful for clubs or businesses that pass many messages and need privacy and security. The program handles mail between accounts and supports auto reply, read again, and delete modes. Online costs $89.95 from Southwestern Data Systems, POB 582, Santee CA 92071, (714) 562-3670.

Circle 528 on inquiry card.

What's New?

SYSTEMS

Hewlett-Packard's New Business Computer

Hewlett-Packard's new desktop business computer, the HP 125, is designed for business managers and professionals. It is especially useful for financial decision making, planning, and analysis. The HP 125 provides word-processing and management communications capabilities. It can be used as a remote terminal to an HP 3000 network, or it can be connected to a mainframe computer through dual RS-232C ports, at speeds up to 9600 bps (bits per second).

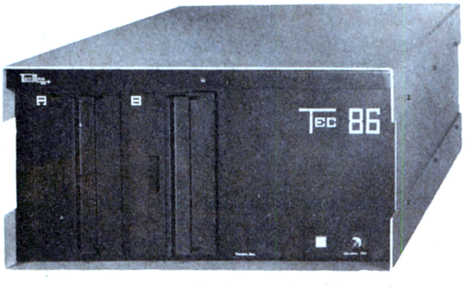
The HP 125 has twin Z80A microprocessors, 64 K bytes of memory, and a separate terminal processor. Most functions are performed by the use of eight "soft keys," whose functions are labeled on the screen. Editing keys are standard on the HP 125, as is the ability to store five pages of displayed information.

The CP/M operating system is employed, and Hewlett-Packard has already created five packages for the system: VisiCalc/125, Graphics/125, Word/125, BASIC/125, and LINK/125. The programs range in price from $125 to $500 and are designed exclusively for businesses and programmers using the HP 125 and CP/M.

There are two HP 125 modules from which to choose: the Model 10 and the Model 20. The Model 10 uses dual 5-inch floppy-disk drives with 500 K bytes of storage. The Model 20 offers 2.4 megabytes of memory on 8-inch disks. Both models can be expanded with additional drives.

The HP 125 systems start at $7460 for the dual 5-inch drives, two RS-232C ports, and an 80-character-per-second thermal printer. Contact the Inquires Manager, Hewlett-Packard, 1507 Page Mill Rd, Palo Alto CA 94304, (415) 857-1501.

Circle 529 on inquiry card.



8086 Boards for the S-100

The Tec-86 is a 16-bit, 8086, S-100 microcomputer system. It includes vectored interrupts, 64 K bytes of dynamic memory (or 32 K bytes of static memory) that are expandable to 1 megabyte, two RS-232C ports, three 8-bit parallel ports, an EPROM (erasable programmable read-only memory) boot for CP/M-86, a double-density floppy-disk controller; dual 8-inch Shugart floppy-disk drives, a metal enclosure, a power supply, and cabling. Software for the Tec-86 includes CP/M-86, Pascal/86, and Microsoft BASIC-86.

The Tec-86 costs $3990. For details, contact Tecmar Inc, 23600 Mercantile Rd, Cleveland OH 44122, (216) 464-7410.

Circle 530 on inquiry card.

MISCELLANEOUS

64 K-Byte Memory Card for Apple II

Legend Industries Ltd's 64 K-byte programmable-memory board for the Apple II switches 16 K-byte banks of memory over the Apple's ROM (read-only memory) address space. The board is fully compatible with the Apple Language Card. Refresh signals are taken from the Apple motherboard by removing a 4116 memory circuit and inserting a jumper into the socket. The 4116 is then reinserted onto the 64 K-byte board. The board is priced at $300. For details, contact Legend Industries Ltd, POB 112, Pontiac MI 48056.

Circle 531 on inquiry card.

COMMLOG

COMMLOG is designed to work with the Apple II and the Hayes Micromodem II. It transforms the combination into a "smart telephone" that displays approximate long-distance time and charges while you talk. It has a built-in calendar routine for logging the day and date. After a call, the person called, duration, date, time, and charges are logged to the disk. Cumulative charges for the month are displayed. COMMLOG has charge codes for attributing calls to different persons or office divisions. It allows standard or military time, and handles holiday rates. COMMLOG has file-maintenance functions for editing, printing, and initializing an auto-dial directory. The program works on an Apple II with 48 K bytes of memory plus Applesoft in ROM (read-only memory). The cost is $39.95 from Harvey's Space Ship Repair, POB 3478, Las Cruces NM 88003, (505) 522-1482.

Circle 532 on inquiry card.

Dynamic-Memory Evaluation Kit

A 64 K-byte Dynamic RAM Evaluation Kit to aid designers in evaluating the MCM6665 HMOS (high-speed metal-oxide semiconductor) programmable memory is available from Motorola's IC Division. The kit is comprised of ten 200 ns MCM6665L20 integrated circuits, a manual request coupon, two data sheets, a Motorola memory selector guide, and a notebook for the designer, and costs only $150. Contact Motorola IC Division, 3501 Ed Bluestein Blvd, Austin TX 78721, (512) 928-6660.

Circle 533 on inquiry card.

In-Circuit Emulator for S-100 Bus

The MICE-48 emulator for the 8048 family of single-circuit microcomputers is S-100-bus-compatible. It can emulate Intel, or equivalent 8035, 8039, 8048, 8049, and 8748 parts; National 8040 and 8050 parts; plus CMOS (complementary metal-oxide semiconductor) versions. MICE-48 runs under CP/M and features trace, unlimited number of breakpoints, display/modify of program memory, external programmable memory, registers, input/output ports, and flags. A mapping command allows the user to map program memory to PROM/EPROM (programmable read-only memory/erasable PROM) or to the emulator's memory.

The MICE-80 emulator, supporting software, and an 8048 macroassembler cost $950. Contact Signum Systems, 726 Santa Monica Blvd, 217, Santa Monica CA 90401, (213) 451-5382.

Circle 534 on inquiry card.

CBASIC/86 for CP/M-86 Systems

CBASIC/86 supports the complete CBASIC language for systems running under CP/M-86. It allows programs written in CBASIC for 8080- and Z80-based systems to be transferred to 8086-based systems without modification. Configured as a CP/M-86 compact-memory model, the system supports a full 64 K bytes of memory for both data and code segments. The suggested retail price is $325 from Compiler Systems Inc, 37 N Auburn Ave, POB 145, Sierra Madre CA 91024, (213) 355-1063.

Circle 535 on inquiry card.

Unlimited Storage for Local Networks

Your local Cluster/One Model A microcomputer network for the Apple II can now have virtually unlimited file storage with the addition of the Version 1.1 File Server from Nestar Systems Inc. Version 1.1 includes a real-time clock/calendar, turnkey applications support, new file-access synchronization modes, and support of DOS 3.3 and Apple Pascal 1.1. It offers a 30% increase in disk speed, and allows 80 concurrently open files.

The Network File Server, Version 1.1 is being shipped with all new Cluster/One Model A orders. Current intallations can be upgraded in the field for a one-time fee. Software and hardware supplements to the Server permit a network of up to 65 Apple II computers to access disk memory in 16.5-, 33-, or 66-megabyte increments. For complete details, contact Nestar Systems Inc, 2585 E Bayshore Rd, Palo Alto CA 94303, (415) 493-2223.

Circle 536 on inquiry card.

MISCELLANEOUS

Simple Video-Display Timer and Controller

The CRT 5047 preprogrammed video-timer and controller integrated circuit is designed for the video-control function in display terminals. It is especially effective for terminals that use 80 by 24 display formats with a 5 by 7 dot-character matrix, although it can be preprogrammed for other display formats.

The CRT 5047 uses a fixed ROM (read-only memory) program that eliminates the software required to specify the display parameters. A two-integrated-circuit combination of the CRT 5047 and the CRT 8002B-003, a video-display-attributes controller, provides all of the electronics for a video terminal. In 100-unit lots, the CRT 5047 costs $18. For more information, contact Standard Microsystems, 35 Marcus Blvd, Hauppauge NY 11787, (516) 273-3100.

Circle 537 on inquiry card.

FIFO from Programmable Memory

The 8X60 FIFO RAM Controller is an integrated circuit that converts programmable-memory circuits into FIFO (first-in, first-out) buffer memories. With it, two asynchronous systems can be interconnected for buffered-data transfer rates exceeding 8 MHz.

The 8X60 provides up to a 12-bit address to a user-selected programmable memory of the desired data width. FIFO depth is selectable to one of four values: 64, 256, 1024, and 4096. Logic is contained within the 8X60 to eliminate contention between read and write operations. Inputs and outputs are standard TTL (transistor-transistor logic), and all address outputs are tri-state. Specifications and pricing are available from Signetics, 811 E Arques Ave, POB 409, Sunnyvale CA 94086, (408) 739-7700.

Circle 539 on inquiry card.

IEEE-488 Interface for the Apple

The IEEE-488 interface card enables Apple II and Apple II Plus computers to monitor productions lines, record and evaluate data, run test equipment, and interface with any apparatus compatible with the IEEE-488 bus. Voltmeters, spectral analyzers, disk drives, and speech synthesizers can be controlled by this card. Also, it can be used to attach non-IEEE-488-compatible peripherals to the bus. The card can be driven by Applesoft or Integer BASIC or any Apple II-supported language. Up to three cards can be installed in the Apple, allowing control of as many as 42 instruments.

The IEEE-488 card costs less than $500. It is available from Apple Computer Inc, 10260 Bandley Dr, Cupertino CA 95014, (408) 996-1010.

Circle 541 on inquiry card.

Single-Circuit CMOS Microcomputers

The Series 80 family of CMOS (complementary metal-oxide semiconductor) single-circuit microcomputers is composed of four microcomputer circuits, peripheral circuits, and a development-support system. The series operates on ISIS- or CP/M-based systems. Series 80 corresponds to the 8048/8049-type NMOS (n-type MOS) devices. In addition to the 8048/8049 instructions, 13 other instructions are offered, including two types of HALT and three types of FLOAT instructions. Eight instructions implement port moves and indirect-decrement functions.

Among the Series 80 family is a development tool, the MPB800, which is an evaluation board that provides real-time emulation and debugging features. Also, there is the MSM80C48 microprocessor, which offers 1 K bytes of ROM (read-only memory) and 64 bytes of programmable memory, and the MSM80C49, which offers twice the memory contents of the C48. Both units feature a timer/event counter, single-level interrupts, 110 instructions, and operate from 5 V ± 10% supply voltage with full TTL (transistor-transistor logic) compatibility. For more information on these products, contact OKI Semiconductor, 1333 Lawrence Expy, Suite 401, Santa Clara CA 95051, (408) 984-4842.

Circle 540 on inquiry card.

ZX80 Enhancements

Sinclair Research Ltd has an 8 K-byte extended BASIC ROM (read-only memory) and a 16 K-byte programmable memory-expansion module for its ZX80 microcomputer. The extended BASIC features 37 new functions that can be programmed by single key strokes, extended and improved graphics, floating-point arithmetic to 9-digit accuracy, and log and trig functions with their inverses. The BASIC ROM costs $39.95, which includes a new keyboard and a manual. The 16 K-byte expansion plugs onto the back of the ZX80. It costs $99.95. For more information, contact Sinclair Research Ltd, One Sinclair Pl, Nashua NH 03061, or call operator 508 at (800) 543-3000.

Circle 542 on inquiry card.

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Flexible Disc 1s Single-Headed Drives Single-Density Media	IBM Compatible (128 B/S, 26 Sectors)	3060	1.99	473071	53428	800506	2305830	FD1-128	FD-1	740-0	S/A 100	15002	FD34-9000	F111111X	421602
	IBM Compatible (128 B/S, 26 Sectors) w/ W.P.N.	3062	2.04	–	–	–	–	–	–	740-0	–	–	FD34-9000	–	–
	IBM Compatible (128 B/S, 26 Sectors) w/ W.P.N. & Hub Ring	3064	2.39	–	–	–	–	–	–	–	–	–	FD34-9000	–	–
	IBM Compatible (128 B/S, 26 Sectors) REVERSIBLE	1729	3.19	473072	54431	–	–	–	FD-2	740/2-0	–	15150	FF34-9000	F171111X	–
	IBM System 6 Compatible	3066	2.04	473077	54561	800509	1669959	–	–	740-0 056	–	15003	FD60-9000	F116111X	–
	IBM Compatible (256 B/S, 15 Sectors)	3109	1.99	473073	–	800584	2305845	–	–	740-3600	–	15005	FD36-9000	F112111X	–
	IBM Compatible (512 B/S, 8 Sectors)	3110	1.99	473074	–	800585	1669954	–	–	–	–	15004	FD60-9000	F113111X	–
	Shugart Compatible, 32 Hard Sector	3015	1.99	470901	53802	101/1	–	FH1-32	FD-132	740-32	S/A-101	15025	FD32-9000	–	421322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3087	2.49	–	54491	–	–	–	–	740-32RH	–	–	–	F37A411X	–
	CPT 8000 Compatible	3045	2.69	–	–	–	–	–	–	–	–	15226	–	–	–
Flexible Disc 1d Single-Headed Drives Double-Density Media	IBM Compatible (128 B/S, 26 Sectors)	3090	2.69	474071	54568	3740/1D	–	FD1-128/M2100	FD-1D	741-0	–	–	FD34-8000	F131111X	423002
	Soft Sector (128 B/S, 26 Sectors) REVERSIBLE	3093	3.69	–	–	–	–	–	–	–	–	–	–	–	–
	Shugart Compatible, 32 Hard Sector	3091	2.69	470801	54596	101/1D	–	FH1-32D	–	741-32	S/A-103	15075	FD32-8000	F33A411X	423322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3088	3.09	–	–	–	–	–	–	–	–	–	–	–	–
Flexible Disc 2s Double-Headed Drives Single-Density Media	Soft Sector (128 B/S, 26 Sectors)	3113	3.09	–	54428	800814	1766870	–	–	–	S/A-150	15153	FD10-4026	F121111X	–
	Soft Sector (256 B/S, 15 Sectors)	3106	3.09	473477	54226	800815	2736700	FD2-256D	–	742-0	–	15154	FD10-4015	F122111X	424612
Flexible Disc 2d Double-Headed Drives Double-Density Media	Soft Sector (Unformatted)	3102	3.09	473485	–	DY150	–	FD2-XDM	FD-2D	743-0	–	15103	DD34-4001	–	425002
	Soft Sector (128 B/S, 26 Sectors)	3115	3.09	–	–	–	–	–	–	–	S/A-150	–	–	–	–
	Soft Sector (256 B/S, 26 Sectors)	3103	3.09	473471	54325	800817	1766872	FD2-256D	–	743-0/256	–	15101	DD34-4026	F144111X	425602
	Soft Sector (512 B/S, 15 Sectors)	3114	3.09	473472	54479	800818	1669044	–	–	743-0/512	–	15100	DD34-4015	F145111X	425612
	Soft Sector (1024 B/S, 8 Sectors)	3104	3.09	473473	54485	800819	1669045	–	–	743-0/1024	–	15102	DD34-4008	F147111X	425622
	32 Hard Sector	3105	3.09	470851	–	101/2D	–	FH2-32D	–	743-32	S/A-151	15125	DD32-4000	F34A411X	425322
	Burroughs B-80 Compatible, 32 Hard Sector	3092	3.09	–	–	–	–	–	–	–	–	–	–	F34A611X	–
	Soft Sector (1024 B/S, 8 Sectors) w/ Hub Ring	3116	3.49	–	–	–	–	–	–	–	–	–	–	–	–
	Shugart Compatible, 32 Hard Sector	3181	3.39	–	–	–	–	–	–	–	–	–	DD32-4000	–	–
Flexible Disc FD Memorex 651 or Equiv. Drive Compatible	FD VI (Vinyl Jacket)	30712003	2.69	470651	–	FDIV	–	–	FD-165	511-0	–	15026	FD65-1000	F61A111X	–
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	10 Hard Sector	3403	1.94	475010	54257	107/1	–	–	MD 110	744-10	S/A-107	15325	MD525-10	M41A211X	441102
	16 Hard Sector	3405	1.94	475016	54258	105/1	–	MH1	MD 116	744-16	S/A-105	15326	MD525-16	M51A211X	441162
	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	–	–	–	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector, w/Hub Ring	3433	2.14	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector, w/Hub Ring	3435	2.14	–	–	–	–	–	–	–	–	–	MD525-16	–	–
Mini Flexible Disc 1d 5¼" Single-Headed Drives Double-Density Media	Soft Sector (Unformatted)	3417	2.14	–	54646	104/1D	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector	3418	2.14	–	54649	107/1D	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector	3419	2.14	–	54652	105/1D	–	–	–	–	–	–	MD525-16	–	–
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	–	–	–	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector w/Hub Ring	3483	2.34	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector w/Hub Ring	3485	2.34	–	–	–	–	–	–	–	–	–	MD525-16	–	–
Mini Flexible Disc 2d 5¼" Double-Headed Drives Double Density Media	Soft Sector (Unformatted)	3421	2.59	–	54624	104/2D	–	–	–	–	S/A-154	–	MD550-01	–	–
	10 Hard Sector	3423	2.59	–	54627	107/2D	–	–	–	–	S/A-157	–	MD550-10	–	–
	16 Hard Sector	3425	2.59	–	54630	105/2D	–	–	–	–	S/A-155	–	MD550-16	–	–
	Soft Sector (Unformatted) w/Hub Ring	3491	2.79	–	–	–	–	–	–	–	–	–	MD550-01	–	–
	10 Hard Sector w/Hub Ring	3493	2.79	–	–	–	–	–	–	–	–	–	MD550-10	–	–
	16 Hard Sector w/Hub Ring	3495	2.79	–	–	–	–	–	–	–	–	–	MD550-16	–	–

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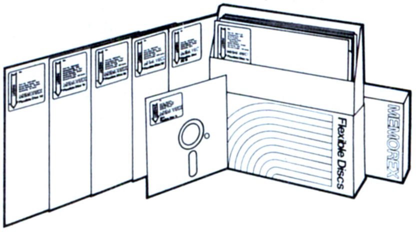

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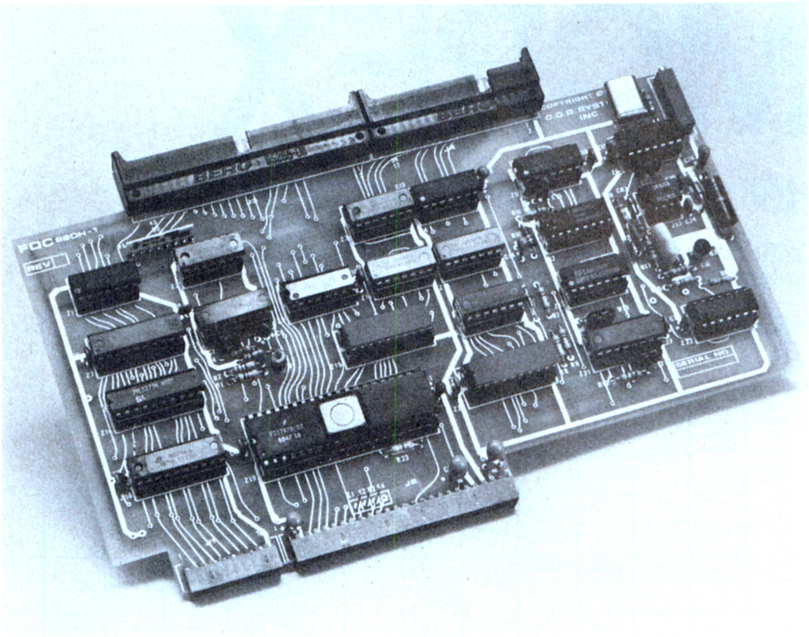

Controller Board for Heath Systems

Users can double the 5-inch floppy-disk storage capacity of Heath 88/89 microcomputers with the FDC-880H floppy-disk-controller board from CDR Systems Inc. The board runs under CP/M 2.2 and is capable of handling as many as four Shugart-compatible 5- or 8-inch drives simultaneously. In addition, the FDC-880H handles single- and double-sided operation and single- and double-density data. The board converts 5-inch hard-sectored disks to soft-sectored double-density.

The FDC-880H unit is supplied with a cable, zero-origin conversion PROM (programmable read-only memory), boot PROM with disk diagnostics, and hardware and software manuals. It costs $695 and is available from CDR Systems Inc, 7667 Vickers St, Suite C, San Diego CA 92111, (714) 275-1272.

Circle 543 on inquiry card.

New AMD PROMs

Advanced Micro Devices' (AMD) new family of PROMs (programmable read-only memories) uses a platinum-silicide fuse, which offers a 97% programming yield. Among the family members are the Am27S40 and the Am27S41. Both are 4 K-byte by 4-bit bipolar PROMs. The Am27S40 has open-collector outputs while the Am27S41 has three-state outputs. The devices offer 50 ns or 35 ns maximum access times, respectively. The Am27PS41 is a three-state, power-switched PROM that relieves power problems by reducing consumption from 875 mW to 425 mW when deselected.

The platinum-silicide fuse is normally programmed with a single pulse. There have been no fuse failures reported in more than 13 billion hours of tests.

In 100-unit lots, prices for this family of PROMs begin at $44.90. For more information, contact Advanced Micro Devices Inc, 901 Thompson Pl, Sunnyvale CA 94086, (408) 732-2400.

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Upgrade Your Casiotone

Robin Whittle, 42 Yeneda St, North Balwyn, Australia, has a technical bulletin that contains extensive yet simple modifications for the Casiotone M-10 keyboard instrument. The M-10 is a hand-held, four-voice synthesizer. With Robin's modifications, the M-10 can have 25 voices, two-octave drop switches, hold, sustain, a milder vibrato than normal, and adjustable tuning. The parts required cost approximately $20. Robin's bulletin, which includes the theory and construction notes, costs $3

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North-Holland Catalog

Books and journals covering computer communications, simulation, artificial intelligence, programming languages and techniques, computing in medicine and biology, and other related subjects are described in the **North-Holland Computer Publications Survey 1980**. Many of the publications are papers from conferences and seminars. For the brochure and price list, contact Elsevier/North-Holland–Journals Information Center, 52 Vanderbilt Ave, New York NY 10017, (212) 867-9040.

Circle 546 on inquiry card.

Handbook Explains EEPROM

The E²PROM Family Applications Handbook describes the operation and application possibilities of Intel's 16 k-bit EEPROM (electrically erasable programmable read-only memory). The handbook shows ways to interface the device to a microprocessor and program it. The handbook is available free from Intel Corporation, Literature Department SV3-3, 3065 Bowers Ave, Santa Clara CA 95051, (408) 734-8102.

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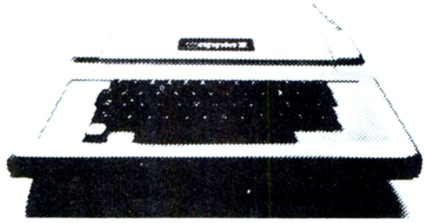

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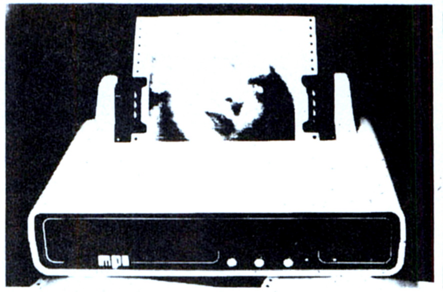

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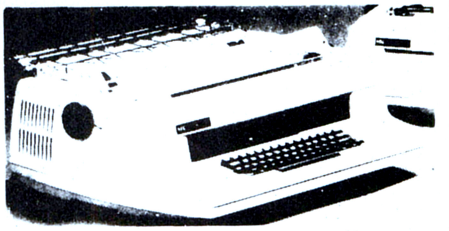

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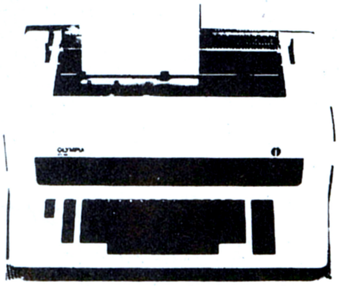

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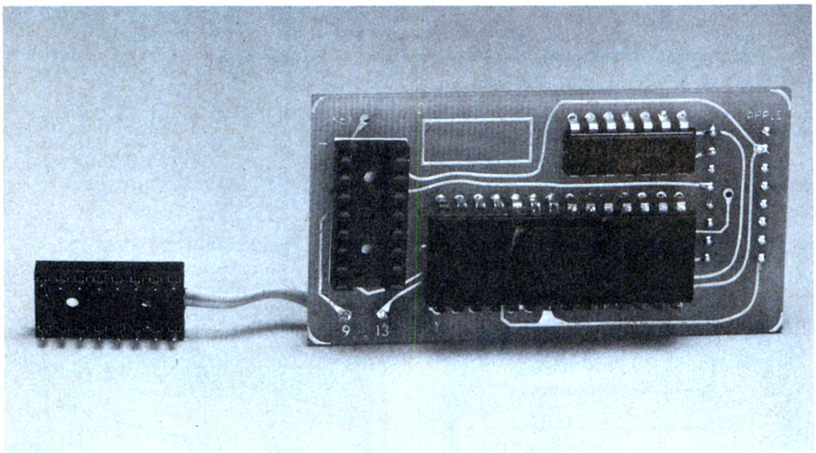

Type-Ahead Buffer

The Model 150 Type-Ahead Buffer for the Apple II features a 40-character type-ahead capability. It eliminates the need to wait for computer prompts before entering the next command or data. No software patches, circuit board cuts, or jumpers are required. The Model 150 costs $49.95 and is available from Vista Computer Company, 1317 E Edinger, Santa Ana CA 92705, (714) 953-0523.

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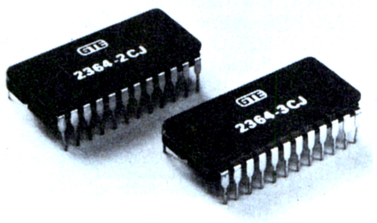

64 K-Bit ROM

GTE's 2364 is a 64 K-bit ROM (read-only memory) with an automatic power-down feature that reduces power requirements. The device operates with a 40 mA current in the active mode and an 8 mA current in the standby mode. It uses a single +5 V supply.

The 2364 is organized as an 8 K-byte by 8-bit unit. The device has access times of 250 and 300 ns. All inputs and outputs are TTL- (transistor-transistor logic) compatible.

In lots of 250, the 300 ns 2364 ROM costs $21.20. Contact GTE Microcircuits Division, 2000 W 14th St, Tempe AZ 85281, (602) 968-4431.

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A Modem for the Atari

The Microconnection is an answer/originate, direct-connect modem for Atari 400 and 800 computers. The Microconnection features autodial/autoanswer operation (optional), which allows an unattended Atari to send messages, text, or other data to a host computer, and automatically answer the telephone and receive data, too.

The Microconnection is Bell 103 compatible and operates at 300 bps (bits per second). Models are available for use without the Atari 850 interface and provide a socket for connection to any serial printer capable of 300 bps operation. A cassette recorder can be plugged into the unit for storage and playback of received data.

With autodialing terminal software, power supply, and a cable, the Microconnection costs $199.50. The autodial/autoanswer option is $79 extra. For complete details, contact the Micro-Peripheral Corporation, 2643 151st Pl, NE, Redmond WA 98052, (206) 881-7544.

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TransFORTH II is a fully compiled, floating-point implementation of fig-FORTH for Apple II, II Plus, or III microcomputers. It has transcendental functions, strings and arrays, high- and low-resolution graphics, Turtlegraphics, and music.

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The Battelle Memorial Institute has a booklet listing the titles of papers and articles from its staff. The booklet contains the names and dates of the publications in which an article or paper appeared and the author(s).

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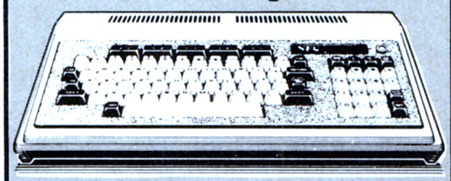

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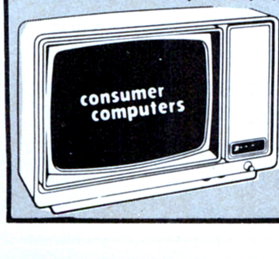

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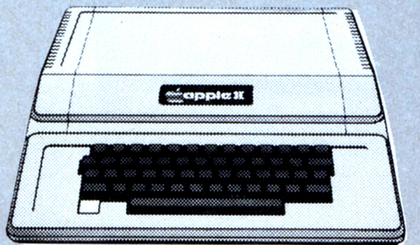

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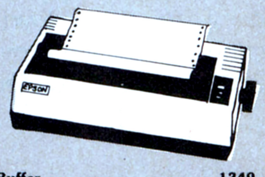

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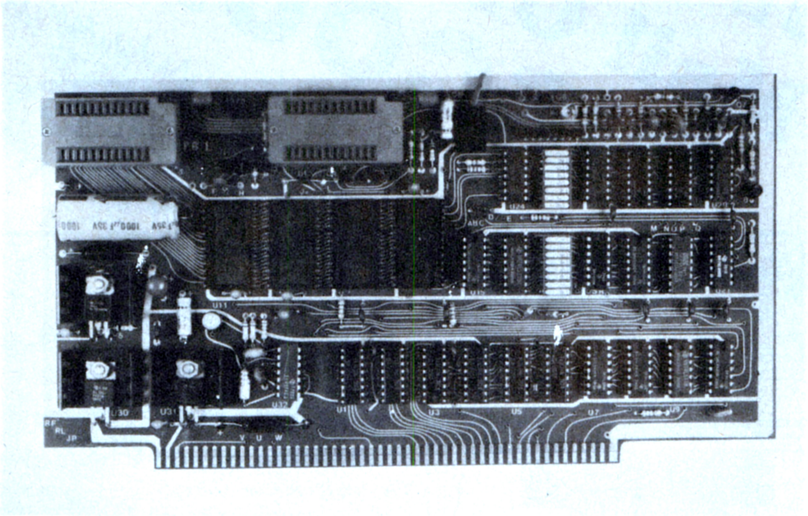

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SSM Microcomputer Products' PB1 S-100 board combines programming and memory capabilities. Four on-card sockets provide a total of 4 K or 8 K bytes of memory, depending upon whether 2708 or 2716 EPROMs (erasable programmable read-only memories) are used. Two programming sockets are provided for a 2708 and a 2716. Separate on-card circuits allow programming of 5 V 2708 and 2716 EPROMs without board modifications. The programming voltage is generated on-board.

The PB1 board with software for programming and verifying EPROMs costs $265. A kit version is available for $179. Contact SSM Microcomputer Products Inc, 2190 Paragon Dr, San Jose CA 95131, (408) 946-7400.

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MicroCOMPOSER-II

MicroCOMPOSER-II is a typesetting system that is added to a Compuwriter II typesetting machine made by CompuGraphic. MicroCOMPOSER-II consists of software and a hardware interface. The hardware interface is placed inside the Compuwriter and connected to a TRS-80 Model I or III microcomputer. MicroCOMPOSER-II reads files created using the TRS-80's word-processing programs and feeds them to the Compuwriter II for a hard-copy printout.

Cove View Press, the marketing agent for this microApplications Associates' system, recommends using the Scripsit or Electric Pencil word-processing programs. The word-processing programs allow text to be formatted to fit MicroCOMPOSER-II standards. The TRS-80 must have at least 32 K bytes of memory and one or more disk drives. MicroCOMPOSER-II costs $1500. For details, contact Cove View Press, POB 637, Garberville CA 95440, (707) 923-3476.

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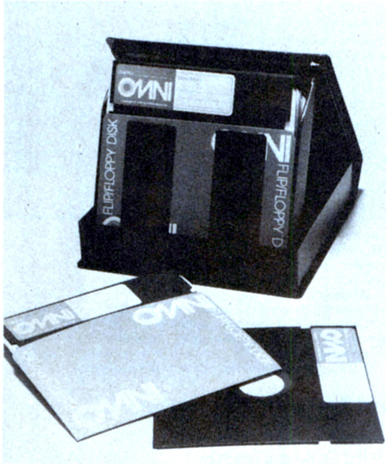

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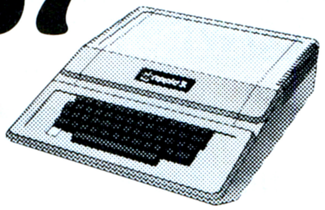

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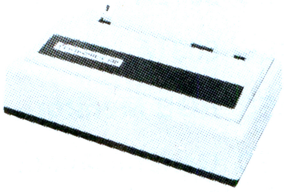

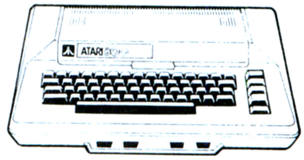

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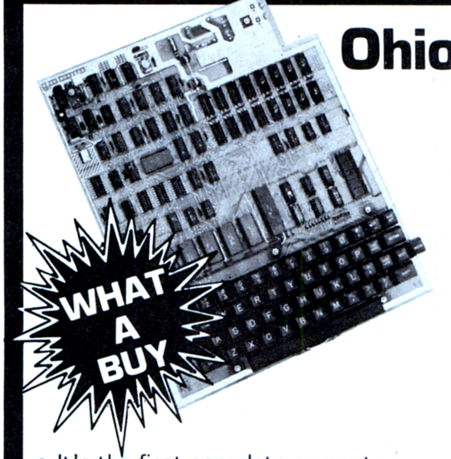

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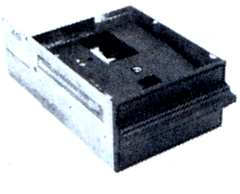

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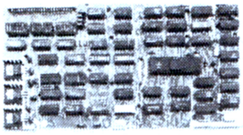

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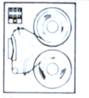

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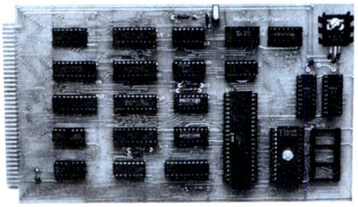

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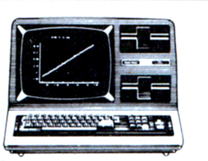

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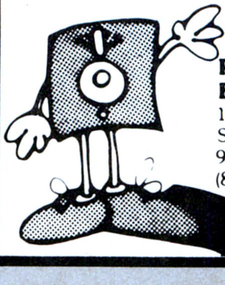

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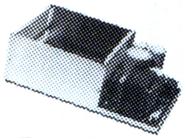

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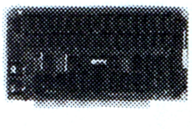

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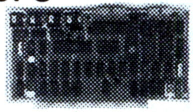

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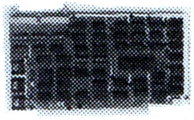

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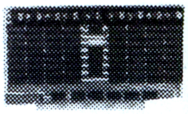

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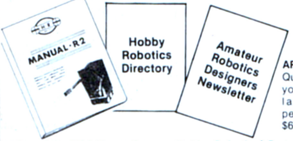

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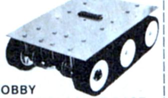

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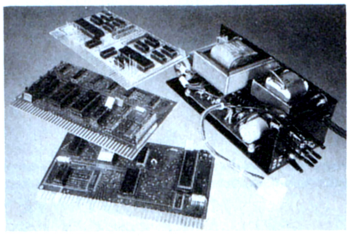

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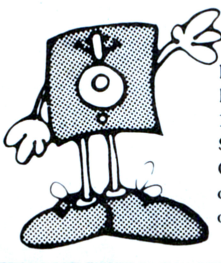

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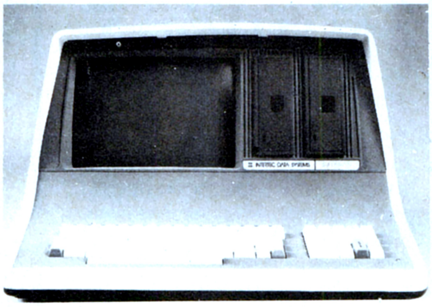

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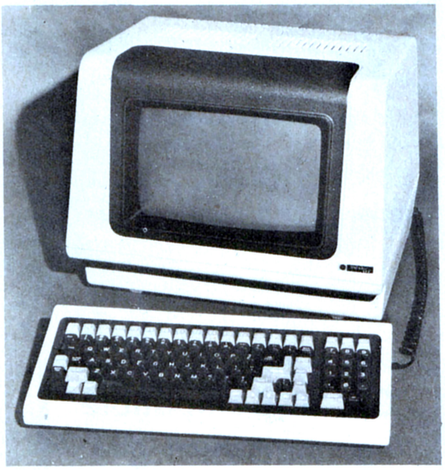

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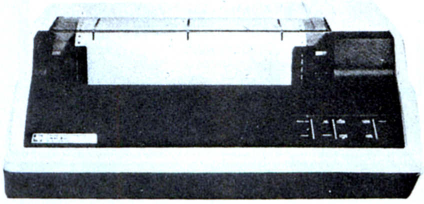

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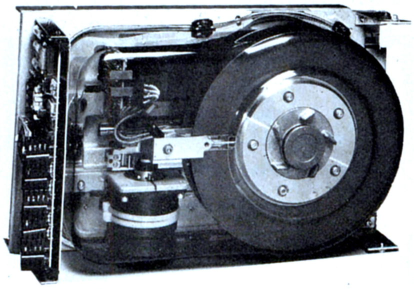

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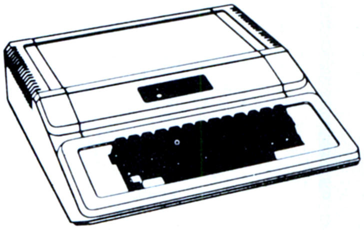

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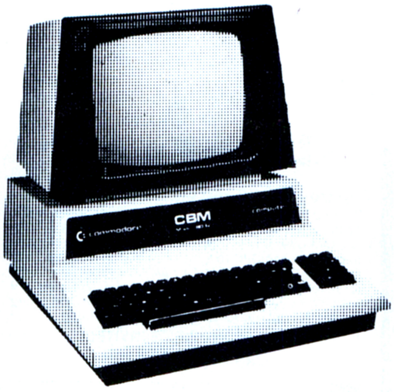

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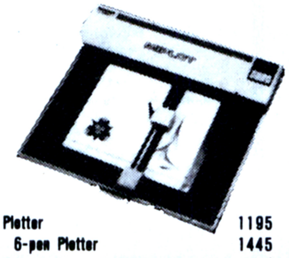

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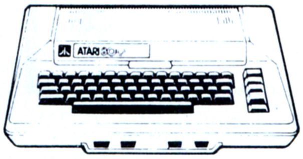

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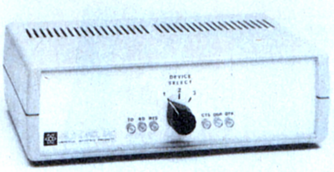

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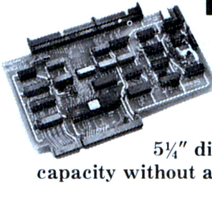

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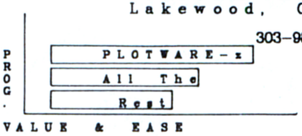

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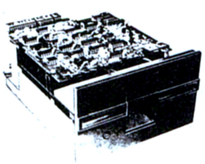

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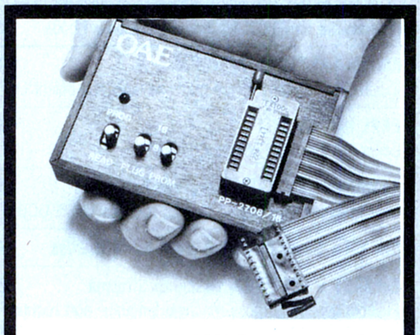

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MM5312	3.90
MM5314	3.90
MM5369	2.10
MM5841	14.45
MM5865	7.95
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CT7015	8.95
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MM5375AG/N	4.90
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7207	7.50
7208	15.95
7209	4.95
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MM53104	2.50

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6820	4.95
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Z80A	11.95
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3341	6.95

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14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
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2 level 14 pin ww .20

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PIN		PIN	
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16	.57	28	1.00
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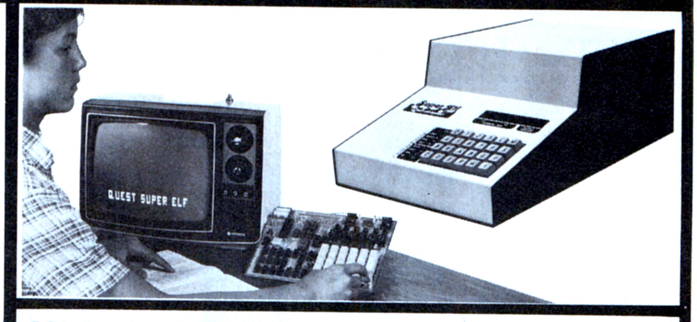

RCA Cosmac 1802 Super Elf Computer $106.95

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The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

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of complete Super Elf system.

Moews Video Graphics **$3.50.** Games and Music **$3.00**, Chip 8 Interpreter **$5.50.**

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This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A IK Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm.17E^{38}$), 32 bit integer ±2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

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Super Monitor VI.I Source Listing	**$15.00**

Elf II Adapter Kit $24.95

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1802 Tiny Basic Source listing	**$19.00**
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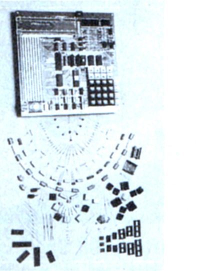

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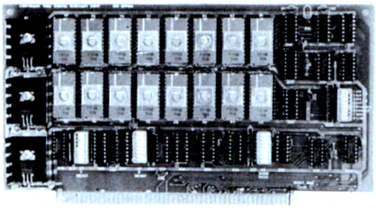

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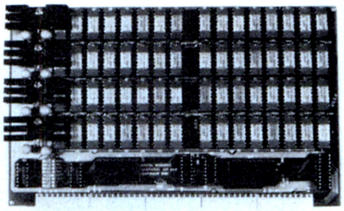

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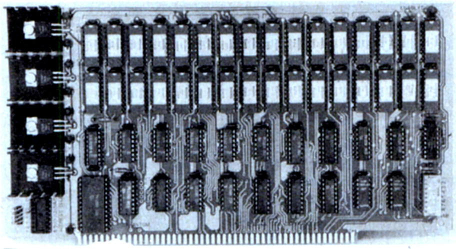

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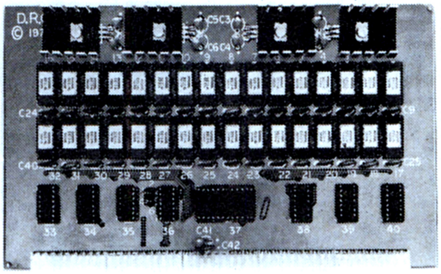

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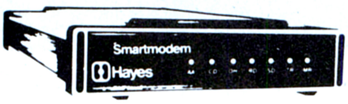

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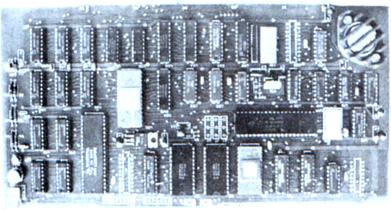

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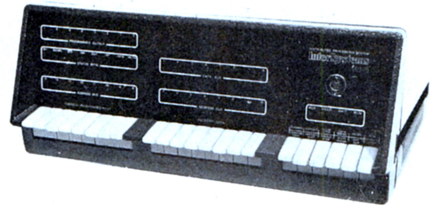

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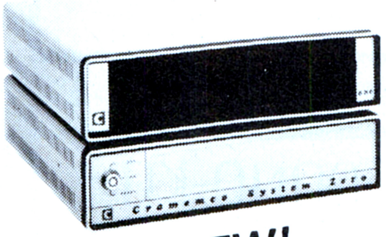

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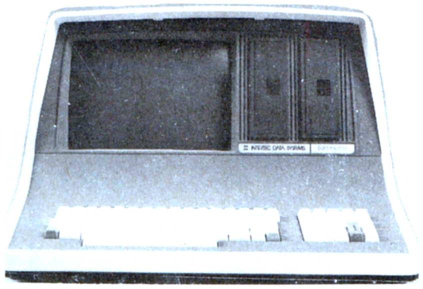

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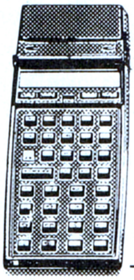

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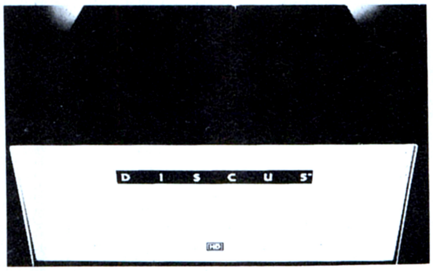

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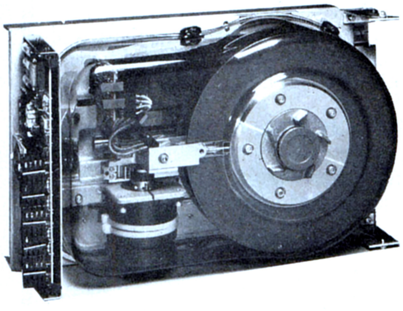

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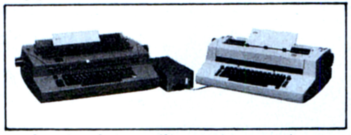

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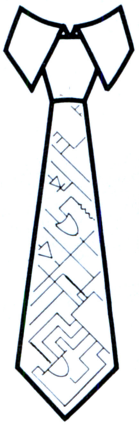

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New 256K dynamic RAM card for S-100 bus. Meets IEEE 696 standard. Full parity, either 8/16 bit data path. Includes acknowledge line for use with asynchronous processors, such as the MC68000. Plus many more advanced features. 200nsec standard, 150 nsec optional.

$3795

OEM pricing available

Empirical Research
Group, Inc.
PO Box 1176
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206-631-4855

Circle 165 on inquiry card.

PRINTER SALE!
SAVE 20-40%

Anadex 9500	$1295
C. Itoh Comet I 125cps	$455
C. Itoh Comet II 15" parallel	$795
C. Itoh Comet II 15" serial	$875
Diablo 630	$2070
Tractor Option	$245
Epson MX-70	$363
Epson MX-80	$477
Epson MX-80 F/T	$599
Epson MX-100 15" paper	$799
Serial board for MX-80	$58
Integral Data Systems 460G	$840
Okidata Microline 80	$403
Okidata Microline 82	$522
Okidata Microline 83	$846
Starwriter 25cps parallel	$1395
Starwriter 25cps serial	$1495
Starwriter 45cps parallel	$1795
Tractor option	$199

CHECKS — VISA — MASTER CARD
Shipping extra. Michigan Add 4%

LYBEN COMPUTER SYSTEMS
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Circle 234 on inquiry card.

FREE DATA BASE

On Computing¹ magazine article data base (1979 and 1980) **FREE** with purchase of **IC-IRS Information Retrieval System.** The best menu driven, multiple key word indexing, filing and retrieval system for the money. (65 "and" ed; 32 "or" ed key words per query—search time in seconds.)

For 8080/Z80 computers with CP/M² compatible op. system, 32K memory and 2 disks.

DATA BASES available to run on IC-IRS:

Computer magazine article abstracts, 6 data bases. 6 major computer magazines from Vol. 1 thru 1980.

CP/M Users Group Programs - indexes of 50 discs.

Software Vendors — 950 names & add. with products.

IC-IRS w/manual & free data base $59.95
DATA BASES $29.95 - $49.95

8" SD and most 5¼" formats.

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² Registered trademark of Digital Research

Circle 173 on inquiry card.

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800	16K	$740.
400	16K	319.
410	Recorder	59.
810	DISK	449.
850	Interface	169.
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	16KRAM	75.
820	Printer	260.
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484	The Communicator	330.

Call or write for discount on software.
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Prices subject to change

Circle 162 on inquiry card.

Rings of Saturn. LEVEL-10 SOFTWARE As the commander of your spaceship on assignment to save your stranded crew near Saturn's rings, you will face assault by enemy ships, ice chunks and other dangers. You have a limited fuel supply and only a short time before their space station blows up. Rings of Saturn has 4 skill levels, 3-D animation, Hi-Res color graphics and sound effects.

Dragon Fire. LEVEL-10 SOFTWARE Slay the dragon Salmadon and accumulate a vast fortune! As the Wizard, the Elf, the Warrior, the Huntress or the Dwarf, you enter a mass of dungeons which are actually the ruins of 10 civilizations built on top of one another. During your quest, you will encounter monsters guarding rooms and passages, each with his own treasure. Be on the lookout for red keys - a magical key is the only way to defeat Salmadon! There is a random key which automatically selects a character, a popular feature for children. There are 5 skill levels.

Kaves of Karkhan. LEVEL-10 SOFTWARE Save the world from the venomous Maldamere! All the characters from Dragon Fire are reunited in a brand new mission. During his travel through the dungeon, the Dwarf discovered a gem. By bringing it to the surface, a malevolent force escapes from the gem and tries to take over the world. The only way to quell Maldamere is to place a piece of the gem on a bier at the top of Mt. Karkhan. You choose a character, hire a crew and begin your ascent. Hi-Res color graphics and 3-D animation simulate walking up and down stairs and through passages. DON'T PLAY IT IN THE DARK!!

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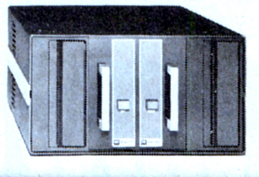
Circle 454 on inquiry card.

Sprint 68 Microcomputer



CONTROL COMPUTER DEVELOPMENT SYSTEM
6800 MPU, serial I/O, 48K RAM, dual 8" drives, WIZRD multitasking DOS, editor, assembler, 16K BASIC, all for $3949.

OPTIONS
C, PL/W, PASCAL, FORTRAN, EROM programmer, analog I/O, parallel I/O, 488 GPIB interface, CMOS RAM/battery, power fail detect/power on reset

WINTEK

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317-742-8428

Circle 431 on inquiry card.

Here we grow again !!!

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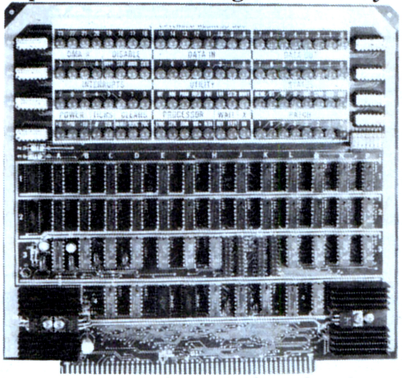
We're celebrating the latest addition to Jade's Retail Division - our new store located in Woodland Hills at 21800 Ventura Blvd.

New from Jade

The Bus Probe

Inexpensive S-100 Diagnostic Analyzer



So your computer is down. And you don't have an oscilloscope. And you don't have a front panel... You're not alone - most computers have their occasional bad days. But without diagnostic equipment such as an oscilloscope (expensive!) or a front panel (expensive!), it can be very difficult to pinpoint the problem. Even if you have an extender board with a superfast logic probe, you can't see more than one signal at a time. You're stuck, right?

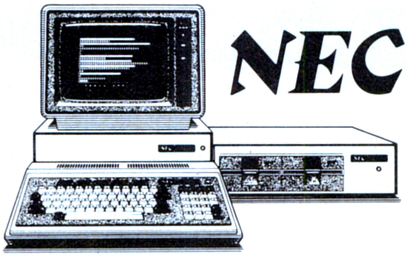
Not anymore; Jade is proud to offer our cost-effective solution to the problems mentioned above: **THE BUS PROBE.**

Whether you're a hobbyist with a cantankerous kluge or a field technician with an anxious computer owner breathing down your neck, you'll find THE BUS PROBE speeds your repair time remarkably. Just plug in THE BUS PROBE and you'll be able to see *all* the IEEE S-100 signals in action. THE BUS PROBE allows you to see inputs, outputs, memory reads and writes, instruction fetches, DMA channels, vectored interrupts, 8 or 16 bit wide data transfers, plus the three bus supply voltages.

An on-board pulse generator can provide repetitive resets, interrupts, or wait states, for trouble shooting.

TSX-200B	*Bare board*	**$59.95**
TSX-200K	*Kit*	**$119.95**
TSX-200A	*A&T*	**$149.95**

NEC



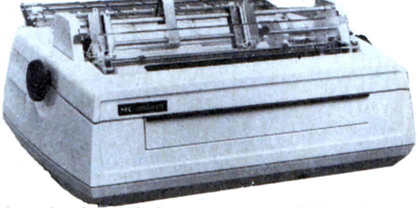
4 MHz Z-80 CPU, 80 x 25 display with graphics and 8 colors, 32K RAM, 24K ROM, parallel/serial/cassette interfaces, upper/lower case, numeric keypad, 10 special function keys, uses CP/M 2.2.

NEC-8001A	*32K CPU/keyboard*	**$1095.00**
NEC-8012A	*I/O with 32K RAM*	**$695.00**
NEC-8031A	*Dual disk unit*	**$1095.00**
VDM-651200	*12" green CRT*	**$269.95**
NEC-1202D	*Hi-res RGB color CRT*	**$1045.00**
VDC-651212	*12" color monitor*	**$479.95**
NEC-9010S	*CP/M 2.2 for NEC*	**$150.00**
NEC-90005	*Gen. accting softwr*	**$375.00**

Intersell

Sellum I

NEC Spinwriter w/ Intelligent Controller



Standard serial, Centronics parallel, and current loop interfaces • Selectable baud rates 50 to 19,200 • Automatic bidirectional printing • Logic seeking • 650 character buffer with optional 16K buffer • 55 characters per second print speed • Comes with vertical forms tractor, ribbon, thimble and cable • Diablo compatible software • Available with or without optional front panel

PRD-55511	*1K no front panel*	**$2795.00**
PRD-55512	*16K no front panel*	**$2895.00**
PRD-55515	*1K w/front panel*	**$2995.00**
PRD-55516	*16K w/front panel*	**$3095.00**

Intersell NEC 3500Q

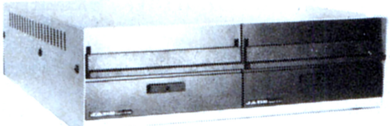
Intersell has announced that, available in September, they will offer a version of the new NEC Model 3500Q Spinwriter (30 cps) that will bring to the customer the same standard features as the Sellum I (except the tractor assembly which is optional on the 3500Q) but incorporating the added features of the NEC Model 3500Q

PRD-55351	*3500Q 1K*	**$1995.00**
PRD-55352	*3500Q 16K*	**$2095.00**
PRA-55100	*Deluxe tractor option*	**$300.00**

JADE

Disk Sub-Systems

Shugart, Siemens, Qume



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

Dual 8" Subassembly Cabinet

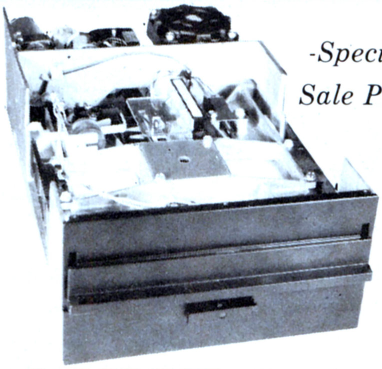
END-000420	*Bare cabinet*	**$59.95**
END-000421	*Cabinet kit*	**$225.00**
END-000431	*A & T*	**$359.95**

8" Disk Drive Subsystems
Single Sided, Double Density

END-000423	*Kit w/2 FD100-8Ds*	**$924.95**
END-000424	*A & T w/2 FD100-8Ds*	**$1124.95**
END-000433	*Kit w/2 SA-801Rs*	**$999.95**
END-000434	*A & T w/2 SA-801Rs*	**$1195.00**

8" Disk Drive Subsystems
Double Sided, Double Density

END-000426	*Kit w/2 DT-8s*	**$1224.95**
END-000427	*A & T w/2 DT-8s*	**$1424.95**
END-000436	*Kit w/2 SA-851Rs*	**$1495.00**
END-000437	*A & T w/2 SA-851Rs*	**$1695.00**



-Special Sale Price-

QUME DT-8

8" Double-Sided, Double-Density Disk Drive

1 Drive	**$524.95 each**
2 Drives	**$499.95 each**
10 Drives	**$479.95 each**

Jade Part Number MSF-750080

SIEMENS 8"

8" Single-Sided, Double-Density Disk Drive

1 Drive	**$384.95 each**
2 Drives	**$349.95 each**
10 Drives	**$324.95 each**

Jade Part Number MSF-201120

Shugart 801R

8" Single-Sided, Double-Density Disk Drive

1 Drive	**$394.95 each**
2 Drives	**$389.95 each**

Jade Part Number MSF-10801R

MPI B-51

5¼" Single-Sided, Double-Density Disk Drive

1 Drive	**$234.95 each**
2 Drives	**$224.95 each**
10 Drives	**$219.95 each**

Jade Part Number MSM-155100

END-000213	*Case & power supply*	**$74.95**

Micro-Sci

Apple Disk Drives

Increased Capacity - Decreased Price

40 or 70 track drives • operates with DOS 3.2 and 3.3, Language System, and the Z80 Softcard • 40 and 70 track drives may be mixed on your Apple II • With two 40 track drives you get a 12.5% increase in capacity, 300% improvement in track-to-track access, and save about 15% • With two 70 track drives instead of four 35 track drives you get the same capacity, 300% improvement in track-to-track access time, and save about 45%.

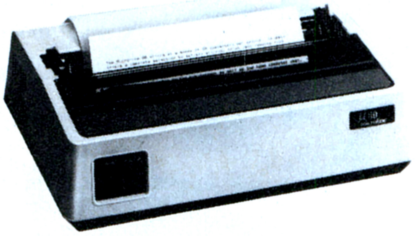
IOD-2340A	*A-40 with cable*	**$399.95**
IOD-2370A	*A-70 with cable*	**$529.95**
IOD-2300A	*Micro-sci controller*	**$89.95**

Circle 210 on inquiry card

Grand Opening Sale

★★★★★★ *San Diego* ★★★★★★ *Hawthorne* ★★★★★★ *Woodland Hills* ★★★★★★

Printers



BETTER THAN EPSON ! - Okidata

Microline 82A *80/132 column,* ***120 CPS****, 9 x 9 dot matrix, friction feed, pin feed, adjustable tractor feed (removable), handles 4 part forms up to 9.5" wide, rear & bottom feed, paper tear bar, 100% duty cycle/200,000,000 character print head, bi-directional/logic seeking, both serial & parallel interfaces included, front panel switch & program control of 10 different form lengths, uses inexpensive spool type ribbons, double width & condensed characters, true lower case descenders & graphics*

PRM-43082	*with FREE tractor*	**$544.95**

Microline 83A *132/232 column, 120 CPS, handles forms up to 15" wide, plus all the features of the 82A.*

PRM-43083	*with FREE tractor*	**$774.95**
PRA-27081A	*Apple card*	**$39.95**
PRA-27082A	*Apple cable*	**$19.95**
PRA-27087A	*TRS-80 cable*	**$24.95**
PRA-43080	*Extra ribbons pkg. of 2*	**$9.95**

INEXPENSIVE PRINTERS - Epson

MX-70 *80 column, 80 CPS, 5 x 7 dot matrix, adjustable tractor feed, & graphics*

PRM-27070	*List $459*	**$399.95**

MX-80 *80 column, 80 CPS, bi-directional/logic seeking printing, 9 x 9 dot matrix, adjustable tractor feed, & 64 graphics characters*

PRM-27080	*List $645*	**$474.95**

MX-80FT *same as MX-80 with friction feed added.*

PRM-27082	*List $745*	**$574.95**

MX-100 *132 column, correspondence quality, graphics, up to 15" paper, friction feed & adjustable tractor feed, 9 x 9 dot matrix, 80 CPS.*

PRM-27100	*List $945*	**$795.00**
PRA-27084	*Serial interface*	**$69.95**
PRA-27088	*Serial intf & 2K buffer*	**$144.95**
PRA-27081	*Apple card*	**$74.95**
PRA-27082	*Apple cable*	**$22.95**
PRA-27086	*IEEE 488 card*	**$52.95**
PRA-27087	*TRS-80 cable*	**$32.95**
PRA-27085	*Graftrax II*	**$95.00**
PRA-27083	*Extra ribbon*	**$14.95**

Dual-Mode 200 - Malibu

200 CPS/9 x 9 matrix or 70 CPS/19 x 18 matrix for letter quality, stores up to 12 different fonts, hi-res dot graphics, single sheet and tractor feed, RS-232C and parallel interfaces

PRM-35200	*Dual-Mode 200*	**$2695.00**

16K Atari . . . $359.95

ATARI 800 - Atari

Complete personal computer with high resolution color graphics, built-in RF modulator, 4 controller ports, internal speaker, 16K RAM & 8K ROM

SYO-2080A	*16K Atari 800*	**$759.95**
Atari 800 with 32K of RAM		**$799.95**
Atari 800 with 48K of RAM		**$849.95**
SYO-2040A	*16K Atari 400*	**$359.95**
MSM-330810	*Disk drive*	**$595.00**
MSM-330815	*Dual drive*	**$1395.00**
IOX-5050A	*850 interface*	**$199.95**
MEX-16853K	*16K RAM module*	**$69.95**
SFI-241011005	*Visicalc*	**$184.95**

Accessories for Apple

16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

MEX-16100K	*TRS-80 kit*	**$25.00**
MEX-16101K	*Apple kit*	**$25.00**
MEX-16102K	*Exidy kit*	**$25.00**

16K RAM CARD - for Apple II

Expand your Apple to 64K, 1 year warranty

MEX-16500A	*Save $70.00 !!!*	**$129.95**

Z-80* CARD for APPLE

Two computers in one, Z-80 & 6502, more than doubles the power & potential of your Apple, includes Z-80 CPU card, CP/M 2.2, & BASIC-80*

CPX-30800A	*A & T*	**$299.95**

8" DISK CONTROLLER

New from Vista Computer, single or double sided, single or double density, compatible with DOS 3.2/3.3, Pascal, & CPM 2.2, Shugart & Qume compatible

IOD-2700A	*A & T*	**$499.95**

8" DRIVES for APPLE

Controller, DOS, two 8" double densisty drives, cabinet, power supply, & cables

Special Package Price	*Kit*	**$1399.95**

CPS MULTICARD - Mtn. Computer

Three cards in one! Real time clock/calendar, serial interface, & parallel interface - all on one card.

IOX-2300A	*A & T*	**$199.95**

APPLE CLOCK - Cal Comp Sys

Real time clock w/battery back-up

IOK-2030A	*A & T*	**$109.95**

PRINTER INTERFACE - C.C.S.

Centronics type I/O card w/ firmware

IOI-2041A	*A & T*	**$99.95**

AIO, ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)

IOI-2050K	*Par & Ser kit*	**$139.95**
IOI-2050A	*Par & Ser A & T*	**$169.95**
IOI-2052K	*Serial kit*	**$89.95**
IOI-2052A	*Serial A & T*	**$99.95**
IOI-2054K	*Parallel kit*	**$69.95**
IOI-2054A	*Parallel A & T*	**$89.95**

A488 - S.S.M.

IEEE 488 controller, uses simple basic commands, includes firmware and cable, 1 year guarantee, (see April Byte pg 11)

IOX-7488A	*A & T*	**$399.95**

Accessories for TRS-80

DISK DRIVES for TRS-80

23% more storage, 8 times faster, 40 track with free patch, 120 day warranty.

MSM-12410C	*Save $125.00 !!!*	**$325.00**

8" DISK DRIVES for MODEL II

2 double density drives with cabinet, power supply, & cables

END-000433	*Kit*	**$1050.00**
END-000434	*Assembled*	**$1250.00**
WCA-5036A	*Cable (required)*	**$29.95**

EPROM ERASERS

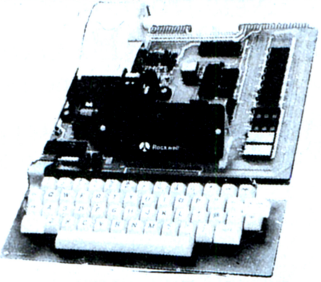
L.S. Engineering UV eraser for up to 48 EPROMs

XME-3200	*A & T*	**$39.99**

Spectronics hi intensity industrial eraser

XME-3100	*Without timer*	**$69.50**

Single Board Computers



AIM-65 - Rockwell

6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals

CPK-50165	*1K AIM*	**$424.95**
CPK-50465	*4K AIM*	**$474.95**
SFK-74600008E	*8K BASIC ROM*	**$69.95**
SFK-64600004E	*4K assembler ROM*	**$39.95**
PSX-030A	*Power supply*	**$64.95**
ENX-000002	*Enclosure*	**$54.95**

4K AIM, 8K BASIC, power supply, & enclosure

Special package price		**$659.95**

Z-80* STARTER KIT - SD Systems

Complete Z-80 computer with RAM, ROM, I/O, display, keyboard, manual, and kluge area.*

CPS-30010K	*Kit*	**$369.95**
CPS-30010A	*A & T*	**$459.95**

SYM-1 - Synertek Systems

Single board computer with 1K of RAM, 4K of ROM, key-pad, LED display, 20ma & cassette interface on board.

CPK-50020A	*A & T*	**$249.95**

Video Terminals

AMBER SCREEN - Volker Craig

Detachable keyboard, amber on black display, 7 x 9 dot matrix, 10 program function keys, 14 key numeric pad, 12" non-glare screen, 50 to 19,200 baud, direct cursor control, auxiliary bi-directional serial port

VDT-351200	*List $795.00*	**$645.00**

VIEWPIONT - ADDS

Detachable keyboard, serial RS232C interface, baud rates from 110 to 19,200, auxiliary serial output port, 24 x 80 display.

VDT-501210	*Sale Priced*	**$639.95**

TELEVIDEO 950

Detachable keyboard, split screen with line lock, etched CRT, programmable function keys, on-screen status line, buffered auxiliary port, 14 x 10 dot matrix, self test, serviced nationwide by General Electric

VDT-901250	*List $1195.00*	**$995.00**

Video Monitors

HI-RES 12" GREEN - Zenith

15 MHz bandwidth, 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.

VDM-201201	*List price $150.00*	**$118.95**

Leedex / Amdek

Reasonably priced video monitors

VDM-801210	*Video 100 12" B&W*	**$139.95**
VDM-801230	*Video 100-80 12" B& W*	**$179.95**
VDM-801250	*12" Green Phospor*	**$169.95**
VDC-801310	*13" Color I*	**$379.95**

12" COLOR MONITOR - NEC

Hi-res monitor with audio & sculptured case

VDC-651212	*Color Monitor*	**$479.95**

12" GREEN SCREEN - NEC

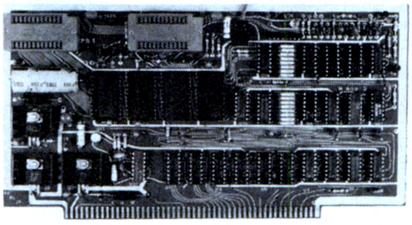
20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200	*12" monitor*	**$269.95**

Grand Opening Sale

★★★★★★ *San Diego* ★★★★★★ *Hawthorne* ★★★★★★ *Woodland Hills* ★★★★★★

S-100 PROM Boards



PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer

MEM-99510K	*Kit*	**$154.95**
MEM-99510A	*A & T*	**$219.95**

PROM-100 - SD Systems

2708, 2716, 2732, 2758, & 2516 EPROM programmer

MEM-99520K	*Kit*	**$219.95**
MEM-99520A	*Jade A & T*	**$269.95**

EPROM BOARD - Jade

16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K	*Kit*	**$79.95**
MEM-16230A	*A & T*	**$119.95**

S-100 Video

VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K	*4 MHz kit*	**$349.95**
IOV-1095A	*4 MHz A & T*	**$439.95**
IOV-1096K	*80 x 48 upgrade*	**$39.95**

VDB-8024 - SD Systems

80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A.*

IOV-1020K	*Kit*	**$399.95**
IOV-1020A	*Jade A & T*	**$459.95**

VIDEO BOARD - S.S.M.

64 characters x 16 lines, 128 x 48 matrix for graphics, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1051K	*Kit*	**$149.95**
IOV-1051A	*A & T*	**$219.95**
IOV-1051B	*Bare board*	**$34.95**

Motherboards

ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard

	6 Slot (5¼" x 8⅝")	
MBS-061B	*Bare board*	**$19.95**
MBS-061K	*Kit*	**$39.95**
MBS-061A	*A & T*	**$49.95**
	12 Slot (9¾" x 8⅝")	
MBS-121B	*Bare board*	**$29.95**
MBS-121K	*Kit*	**$69.95**
MBS-121A	*A & T*	**$89.95**
	18 Slot (14½" x 8⅝")	
MBS-181B	*Bare board*	**$49.95**
MBS-181K	*Kit*	**$99.95**
MBS-181A	*A & T*	**$139.95**

Mainframes

MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

ENC-112105	*Kit*	**$329.95**
ENC-112106	*A & T*	**$399.95**

DISK MAINFRAME - N.P.C.

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S-100 Memory

MEMORY BANK - Jade

4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B	*Bare board*	**$49.95**
MEM-99730K	*Kit, no RAM*	**$199.95**
MEM-16730K	*16K kit*	**$219.95**
MEM-32731K	*32K kit*	**$239.95**
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MEM-64733K	*64K kit*	**$279.95**
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MEM-48632K	*48K kit*	**$315.95**
MEM-64633K	*64K kit*	**$335.95**
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4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

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64K static S-100 RAM card, 4-16K banks, up to 8 MHz

MEM—64400A	*A & T*	**$825.00**

32K STATIC RAM - Jade

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MEM-32151K	*32K 4 MHz kit*	**$299.95**
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4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

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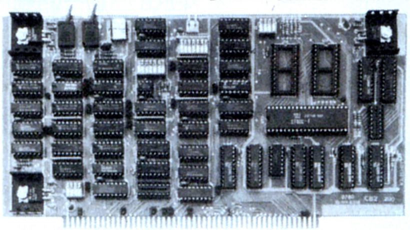
S-100 CPU



CB-2 Z-80 CPU - S.S.M.

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74LS22	.25	74LS158	.75	74LS347	1.95
74LS26	.30	74LS160	.90	74LS348	1.95
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74C14	1.45	74C374	2.70
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74C30	.35	74C902	.80
74C32	.50	74C903	.80
74C42	1.70	74C904	.80
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74C76	1.90	74C908	2.00
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4011	.35	4049	.55	4511	.95
4012	.35	4050	.55	4512	.95
4013	.45	4051	.95	4514	2.25
4014	.95	4052	.95	4515	2.25
4015	.95	4053	.95	4516	1.50
4016	.45	4055	2.75	4518	1.25
4017	.95	4056	2.75	4519	1.25
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4020	.95	4066	.75	4526	1.25
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SN7414N	.59	SN74150N	1.09
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SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.78
SN7423N	.29	SN74156N	.78
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.25	SN74160N	.88
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SN7439N	.29	SN74166N	1.20
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SN7447N	.65	SN74177N	.75
SN7448N	.79	SN74179N	1.34
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SN7451N	.19	SN74181N	1.75
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SN7473N	.34	SN74191N	1.15
SN7474N	.34	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.34	SN74194N	.85
SN7479N	4.60	SN74195N	.68
SN7480N	.49	SN74196N	.85
SN7482N	.95	SN74197N	.85
SN7483N	.55	SN74198N	1.39
SN7485N	.65	SN74199N	1.39
SN7486N	.35	SN74221N	1.19
SN7489N	1.75	SN74251N	.95
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SN7491N	.57	SN74279N	.75
SN7492N	.45	SN74283N	1.40
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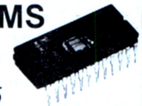

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MPI 92 Double Track Density Double Side, 160 Track	475.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith. Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod.	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

$24.95 TRS-80/APPLE $24.95

MEMORY EXPANSION KITS.

4116's, 16K (200/250 ns.)

8 pcs for $24.95

Specify Computer

Call For Volume Pricing

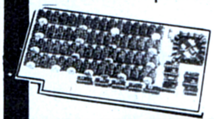
16K RAM

CENTRONICS PRINTER

Model 737
- Centronics complete printer
- The 737 has everything. Check and compare the features.
- New low price **$835.00**

32K STATIC RAM BOARD

2 or 4 MHz Expandable uses 2114L's



S-100

16K 4 MHz Kit	159.95
16K 4 MHz A&T	217.95
32K MHz Kit	289.95
32K 4 MHz A&T	339.00
Bare Board	39.95
Bare Bd. w/all parts less mem	99.95

NEW! from Zilog

Z-8 CPU comes with Tiny Basie & debug program on the I.C.

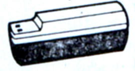
$69.95 w/data

BIPOLAR CPU SALE

Signetics 8 × 300 8 bit CPU

While stock lasts 14.95 ea.

UV "Eprom" Eraser



Model UVs-11E $69.95

Holds 4 Eprom's at a time

Backed by 45 years experience

Model S-52T... $325.00

Professional Industrial Model

NON-LINEAR SYSTEMS, INC. NLS

TOUCH TEST 20

DIGITAL MULTIMETER $\$319^{95}$

AS LOW AS 100^{00}

BECKMAN DIGITAL MULTIMETERS

TECH 300 Digital Multimeter	$110
TECH 310 Digital Multimeter	$140
TECH 330 Digital Multimeter	$189
VC-201 Vinyl Carrying Case	$10
DC-202 Deluxe Carrying Case	$24
HV-211 High Voltage Probe	$35
RP-221 RP Probe	$35
Ct-231 AC Current Clamp	$42
DL-241 Delxue Test Lead Kit	$10
TL-242 Square Test Leads	$6

INTERSYSTEMS

The Preferred S-100 Box

The new Series II CPU Board features a 4 MHz Z-80A CPU and full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

DPS-1, List **$1795**

ACP Price **$1499**

SYSTEM 2A with Z-80A CPU 4 MHz, 64K RAM, I/O Board, 20 slots, front panel, double density disk controller board. Full 1-year warranty.

List **$3795** ACP Price **$2995**

NEC PC-8000 Series Microcomputer System.

NEW INTRO PRICING $1099.00

- Z-80A CPU 4 MHz
- 5 user programmable function keys
- 82 Keys with numeric keypad
- 160x100 resolution
- 80 character screen

PC-8001A Microcomputer w/32KRAM	$1295.00	1099.00
PC-8012A I/O Unit w/32K RAM, Expansion slots	795.00	699.00
PC-8031A Dual Mini-Disk Drive Unit	1295.00	1099.00
PC-8032A Add-On Dual Mini-Disk Drive Unit	1095.00	949.00
PC-8023A Impact Matrix Printer, Tractor/Friction Feed	860.00	769.00
PC-8094A Cable for PC-8023A Printer	49.95	44.95
JB-1201M(A) High Resolution Green Monitor	265.00	239.00
JC-1202DH(A) High Resolution Color Monitor w/RGB Input	1195.00	1049.00
PC-8091A RGB Cable for JC-1202DH(A) Color Monitor	19.95	17.95
Basic Language Learning Guide		19.95
PC-8001A Microcomputer Reference Manual		19.95
PC-8012A I/O Unit User's Manual		14.95
PC-8031A Dual Disk User's Manual		14.95

MICROPROCESSORS

Z8001 16 bit to 8Mb	$189.00
Z8002 16 bit to 64K	149.00
Z80	9.95
Z80A	13.95
F-8 (3850)	16.95
2650	16.95
CD 1802	9.75
8080A	4.75
8080A-4MHz	19.95
SALE 8085	14.95
8008-1	14.95
2901	9.90
2901A	14.95
2903 4-bit Superslice	29.95
TMS 9900JL	49.95
CP1600	39.95
6502	9.95
6502A	16.95
IM6100	29.95
6800	**11.75**
6800B 2.0 MHz	19.95
6802P	17.95
8035	14.95
8039	19.95
INS 8073N	24.95
8755	49.95
8748	69.95
6809	37.95
8086	69.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith Processor	175.00
9513 Univ. Timing	79.95
AM9517 DMA Controller	18.95
AM9519 Universal Interrupt	18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	36.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHZ	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

8155/8156 I/O	24.95
8755 I/O with Eprom	64.95
8202 Dyn. Ram Cont.	34.95
8205/74S 138 Decoder	3.95
8212 8 bit I/o	2.75
8214 Priority Int.	5.25
8216 Bus Driver	2.75
8224 Clock Gen.	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	2.95
8T26 Bus Driver	2.95
8228 Sys. Control	4.50
8238 Sys. Cont.	5.50
8243 I/O Exp.	9.50
8250 Asyn. Comm	15.95
8251 Prog. I/O	6.95
8253 Int. Timer	12.95
8255 Prog. I/O	6.50
8257 Prog. DMA	16.95
8259 Prog. Int.	15.95
8275 CRT Controller	45.95
8279 Prog. Keyboard	15.95

6800 SUPPORT CHIPS

6810 128 x 8 Ram	4.75
6820	6.50
6821	6.50
6828 Priority Int.	10.75
6834-1 512 x 8 Eprom	16.95
6845/HD46505 CRT Cont.	29.95
6847 Color CRT	29.95
6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 1.0MHz OSC	25.95
6875	6.95
6880 Bus Driver	2.19
MC68488	19.95
68047	24.95

6502 SUPPORT CHIPS

6520 PIA	7.50
6522 Mult.	11.95
6530-002,003,004,005	21.95
6532	19.95
6551	19.95

BIPOLAR PROMS

We do Custom Programming

82S23/6330/5600/74S188	4.25
82S115 (512x8)TS	12.95
82S123/5610/74S288 (32x8)TS	4.25
82S126/5603/74S387 (256x4)OC	4.25
82S129/5623/74S287 (256x4)TS	4.25
82S130/5604/74S570 (512x4)OC	6.50
82S131/74S571 (512x4)TS	6.95
82S137/74S573 (1024x4)TS	12.95
82S141/3624/74S474 (512x8)TS	12.95
82S147/74S472 (512x8)TS	12.95
74S471/6309 (256x8)TS	7.95

MOS PROMS

2764 (8Kx8)TS	89.95
2732 (4Kx8)TS	16.95
2716/2516;5V (2Kx8)TS	8.95
TMS2716, ± 5V, 12V	17.95
2758, 5V, (450NS)	7.50
2708 (450NS)	5.75
2708 (650Ns)	5.25
1702A	5.75
MM5203AQ	14.50
MM5204Q	9.95

CHARACTER GEN.

2513-001 (5V) Upper	9.50
2513-005 (5V) Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM66710 Ascii Shifted	12.95
MCM66740 Math Symbol	13.45
MCM66750 Alpha Control	13.45

UARTS/BAUD RATE

TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	4.95
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	**9.95**
MC14411	11.95
4702	14.95
WD1941	9.95
COM 5016	16.95
INS 8250	15.95

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75

STATIC RAMS

SALE 2102 .89

	1-24	25-99	100
21L02 450ns	1.30	1.25	.99
21L02 250ns	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114N (450 NS.)	3.75	3.50	3.25
2114L-250ns. (4045)	6.50	5.95	5.50
2114L-450ns. (4045)	4.75	4.25	3.95
4044 250 ns	8.95	7.50	6.90
4044 450ns.	5.95	5.95	**4.75**
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns.)	9.95	8.35	8.25
6518 1K x 1 CMOS	7.95	7.95	7.25
2147 Low Power 4K Static	9.95	8.95	6.95
93415	9.95	8.95	8.50

DYNAMIC RAMS

416/4116 16K (16 Pin)	2.49
Set of 8 416's 200 Ns	24.95
4115 8K (16 Pin)	2.49
4050 4K x 1 (18 Pin)	4.95
4060 4K x 1 (22 Pin)	4.95
4096 4K x 1 (16 Pin)	3.95
2104 4K x 1 (16 Pin)	4.75
4027 4K x 1 (16 Pin)/UPD 414	4.95

5261	1.95	1103	.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
		6002	1.50

64K RAMS $19.95

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Wire Wrap 3 Level Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No.	Size	Color	Description	Price
DL704	300	Red	Comm. Cathode	.99
DL707	300	Red	Comm. Anode	.99
FND357	357	Red	Comm. Cathode	.99
FND501	500	Red	Comm. Cathode (+1)	.99
FND503 (500)	500	Red	Comm. Cathode	.99
FND507 (510)	500	Red	Comm. Anode	.99
FND508	500	Red	Comm. Anode (+1)	.99
FND530	500	Green	Comm. Cathode	1.49
FND550	500	Orange	Comm. Cathode	1.49
FND803 (800)	800	Red	Comm. Cathode	1.75
FND807 (810)	800	Red	Comm. Anode	1.75
HP5082-7340	600	Red	4 x 7 Hexidecimal	25.95
HP5082-7300	600	Red	4 x 7 Sgl. Digit RHD	18.95
HP5082-7731	300	Red	Comm. Anode	.75
TIL305	-	Red	Array 5 x 7	7.95
TIL308	270	Red	Numerical Display	10.95
TIL309	270	Red	Numerical Display	9.95
TIL311	270	Red	4 x 7 Hexidecimal	10.95
MAN2A	320	Red	Array	5.95
MAN10A	270	Red	Alpha Numeric	8.95
XAN3061	300	Red	Comm. Anode Right DP	1.25
XAN3062	300	Red	Comm. Anode Left DP	1.25
XAN3063	300	Red	Overflow. CA. Left DP	1.25
XAN3064	300	Red	Comm. Cathode Right DP	1.25
XAN3051	300	Green	Comm. Anode Right DP	1.99
XAN3052	300	Green	Comm. Anode Left DP	1.99
XAN3053	300	Green	Overflow CA. Left DP	1.99
XAN3054	300	Green	Comm. Cathode. Right DP	1.99
XAN3081	300	Yellow	Comm. Anode. Right DP	2.10
XAN3082	300	Yellow	Comm. Anode. Left DP	2.10
XAN3083	300	Yellow	Overflow CA. Left DP	2.10
XAN3084	300	Yellow	Comm. Cathode. Right DP	2.10

IC SPECIAL PURCHASE

82S09 64x9 Ram	8.95
DP8304 Octal Driver	2.95
DAC86EX D/A Conv.	6.95
MC1650 Hi Speed A/D	7.95
MC6852 SSDA	3.49
MC10145 16x4 ECL Ram	4.50
MK3850/F8 CPU	4.95
MK3853 Static Mem I/O	4.95

SN75136	.46	78M06	.49
MC10210	.89	79M06	.49
LM339	.79	74157	.49
LM710CN	.29	74161	.49
LM711CN	.29	74C74	.39

ICM 7045 Precision StopWatch	23.95
ICM 7207 Oscillator Controller	7.50
Seven Decade Counter 7208	18.95
MC14433P 3½ Digit A/D Converter	13.95
ICL 8211 Voltage Reference	1.95
LM 1850N Ground Fault IC	3/1.00
LM 2900N Quad Amplifier	2/1.00
LM 2917N Freq. to Volt Conv.	2/1.99
AY-3-3550 4¾ digit DMM	24.95
AY-5-3507 40MHz DVM	9.95
MEM 4963 Mosfet Smoke Detector	7.95
27S08 32 x 8 Prom (IM 5600)	2.95
ULN 2003A 7 channel Driver	.99
MCM 14505 64 bit Static Ram	6.95
MOC 1003 (4N28) Opto Coupler	3/1.00
SPX33 Opto Coupler	3/1.00
IH 5045 CMOS Switch DBST	4.50
UA 3045 Trans. Array	1.25
TR 1402A UART	1.95
MK 1007 Dyn. Mem. Shift Reg.	3.95
5318 TV Ch. Disp. Circuit	4.50
8080A 8 Bit CPU	4.95
8700 CJ 8 Bit A/D	9.95
MM5280/VPD 411/C2 107/TMS 4060/ 4Kx1 Dynamic 22 Pin RAM	1.75
6604/VPD 414/4027/2660/MK 4096/ 4Kx1 Dynamic 16 Pin	1.95

7520/25	.50	LM 387	1.25
1488/1489	2/1.99	LM 4558	3/1.99
LM323K	4.95	RC 4136	2/1.99
MC1372	8.95	RC 4131	2/1.99
MM5298-4A/B	2.95	COM 5027	39.95
LM 377	1.25	COM 5037	49.95
LM380	1.25		

VERBATIM DISKETTES

100% CERTIFIED ERROR-FREE!

● 35 TRACKS, DOUBLE DENSITY, SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE/BOX 10
525-01	Soft Sectored TRS 80, etc	$29.95
525-10	10 Hole Hard NS, Apple, etc	$29.95
525-16	16 Hole Hard Micropolis	$29.95

● 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼" W/HUB REINFORCEMENT RING

577-01	Soft Sectored TRS 80, etc	$32.25
577-10	10 Hole Hard NS, Apple, etc	32.25
577-16	16 Hole Hard Micropolis	32.25

● 40 TRACKS, DOUBLE SIDED, DOUBLE DENSITY 5¼

550-01	Soft Sectored SA 450, MPI 52	$39.95
550-10	10 Hole Hard BASF, WANGCO	$39.95
550-16	16 Hole Hard Micro²	$39.95

● 8" 100% CERTIFIED DISKETTES

FD800-01	Soft, Single Density, 3740	$33.50
FD800-32	32 Hard Single Density Shug	33.50
FD802-01	Soft, Double Density, 3740	44.80
FD850-01	Soft, Double Sided, Double Density, 3740	49.80

VOLUME DEALER PRICING AVAILABLE

WE ALSO STOCK DYSAN-CALL

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1771-01 8" & Minifloppy	24.95
1781 Dual Floppy	29.95
1791-01 Dual Floppy	36.95
1791-02 Dual Floppy	44.95
1793 DD, DS Floppy	44.95
1797 DD, DS Floppy	54.95
1691 Data Separator	18.95
2143 Clock Gen.	18.95

FLOPPY CHIP SET

Double Density

Double Sided Includes: 1797 1691 2143

$79.95/set

A/D CONVERTERS

8700 8 bit Binary	13.50
8701 10 bit Binary	22.00
8703 8 bit TS	13.50
9400 Volt to Freq. Conv.	7.25
8750 3½ Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	5.95
DACOI D to A	5.95
DAC08	9.95
DAC 100	9.95

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AY38500-1 6 Games B/W	4.95
AY38515 Color Converter	2.95
AY38603-1 Roadrace Game	8.95
AY38606-1 Wipeout Game	9.50
AY38607-1 Shooting Gallery	8.95
AY38910 Sound Generator	12.95
SN76477 TI Sound Generator	3.95
MM5320/21 TV Synch Gen.	9.95
MM5369 Prescaler	3.95
LM1889 RF Modulator	3.95
MM57100 NSC Color TV	6.95
MM57104 Clock Gen.	3.75
M&R Modulator	29.95

WAVEFORM GEN.

8038 Function Gen.	4.50
MC4024VCO	2.95
LM566 VCO	1.95
XR2206 Function Generator	5.25

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2504V	1.49	MM500H	.50
2507V	1.49	MM5056N	2.95
2517V	1.49	MM5060N	2.95
2524V	1.49	2510A	1.95
2525	1.49	2847	4.95
2527	1.49	3341	4.95
2528	1.49	3351	17.95
2529	1.49	3357	6.95
2533	1.49	9403	24.95
3347	5.95	9408	9.95

CTS DIPSWITCHES

CTS206-2	1.75	CTS206-7	1.75
CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
CTS206-6	1.75	CTS206-10	1.95

CONNECTORS (GOLD)

DB25P (RS232)	3.25
DB25S Female	3.75
Hood	1.25
Set w/Hood, Sale	$7.50
22/44 W/W, S/T, KIM	2.95
43/86 W/W, S/T, MOT	6.50
50/100 S-100 Connector w/w	4.95
50/100 S-100 Connector s/t	3.95

NAKED PC

S-100 Sound Board	$34.95
8080A CPU	34.95
32K Static RAM (2114)	39.95
8K Eprom (2708)	24.95
2708/2716 Eprom	34.95
ACP Proto Bd.	22.95
Vector 8800 Proto	22.20
Vector 8803 11 slot MB	29.95
ACP Extender w/Conn	18.95
13 Slot MotherBoard (WMC)	32.95
9 Slot MotherBoard (WMC)	29.95
8 Slot Mother (Expandable)	34.95
Floppy PCB (8" SHUGART)	39.95
S100 (AY5-8910) Sound Bd.	34.95
Apple Sound Bd.	24.95

PRINTERS

EPSON

MX-80	$495.00
MX-80 FT	595.00
MX-100	895.00
MX-70	425.00
Centronics 739	799.00
Vista V-300/25 cps	1495.00
V-300/45 cps	1795.00
Malibu 165	1995.00
Anadex 9500/9501	1450.00
Base II 800 MST	549.00

TERMINALS

TELEVIDEO

912C	$799
920C	$849
950C	$995
AddS Viewpoint	$599
Ampex Dialog 80	$1025
Soroc IQ120	$699
IQ135	$899
IQ140	1149.00

SANYO MONITORS

VM4509 9" BW Sale Price	159.95
DM5012 12" B/W	239.00
DM5112 12" Green	249.00
DM6013 13" Color	415.00
NEC Green	259.00
AMDEK/LEEDEX Video 100	149.00
AMDEK/LEEDEX 13" Color	399.00
AMKEK/LEEDEX 12" Green	179.00

TERMS: Use check, M/C, VISA, AMEX, CB, or COD. COD requires 25% deposit. Charge Orders please include expiration date. Foreign pay U.S. Funds. Order by phone, mail or TWX. MINIMUM $10.00. Please include magazine issue and phone no. SHIPPING: U.S.A. add $2.00 for first 2 lbs. For surface add 30¢ for additional lbs. For air add 70¢ for additional lbs. FOREIGN: Add 10% shipping and handling. COD's $1.85 extra. Not responsible for typos. Some items subject to prior sale. We reserve right to limit quantities, some items subject to precious metal adder. Retail pricing may vary from Mail Order. We reserve the right to substitute manufacturer.

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STORE #2: 542 W. Trimble Road, San Jose, CA 95131 • (408) 946-7010

**Retail prices may vary.

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Direct Order Lines: (714) 558-8813

(800) 854-8230 or (800) 854-8241

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Santa Ana, CA 92705 TWX: 910-595-1565

Circle 9 on inquiry card.

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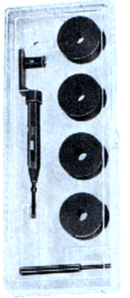
PRODUCTS

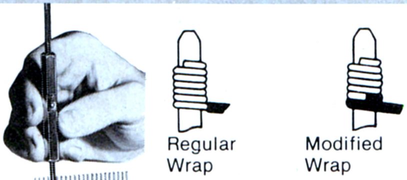


JUST WRAP KIT

Just Wrap tool for daisy chain wiring. Tool strips as it wraps and cuts. Includes one 50 foot spool of wire.

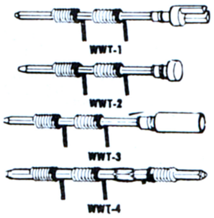
Part No.	Description	Price
JW-1*	Just Wrap Tool	$14.95
JWK-6	Tool w/4 Spools and JUW1	24.95
R-JW*	50 Ft. Replacement Wire	3.49
JUW-1	Unwrapping Tool	3.49

*Specify Color: Red, Blue, White or Yellow.



HAND WRAP TOOL

Part No.	Description	Price
WSU30	Regular	$6.95
WSU30M	Modified	7.95



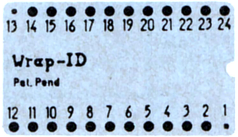
TERMINALS

- .025 (0,63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated

25 PER PKG.

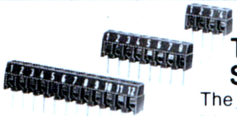
Part No.	Description	Price
WWT-1	Slotted Terminal	$4.98
WWT-2	Single Sided Terminal	2.98
WWT-3	IC Socket Term.	4.98
WWT-4	Double Sided Terminal	1.98
INS 1	Insertion Tool for above	2.49

SOCKET WRAP — ID



Slipped onto socket before wrapping to identify pins.

Part #	Price	Bulk Price	Part #	Price	Bulk Price
14ID	1.49/10	5.50/100	22ID	1.49/5	5.95/50
16ID	1.49/10	5.95/100	24ID	1.49/5	5.95/50
18ID	1.49/10	5.00/50	28ID	1.49/5	6.50/50
20ID	1.49/5	5.00/50	40ID	1.49/5	5.00/25



P.C.B. TERMINAL STRIPS

The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1,8-0, 25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

Part No.	Description	Price
TS- 4	4-Pole	$1.69
TS- 8	8-Pole	2.59
TS-12	12-Pole	3.49
TS6MD	2-Pole Interlocking	3/1.79

DESOLDERING PUMP

Easy one hand operation. Rugged all metal construction. Replaceable TEFLON® Tip. Self cleaning on each stroke. Suction precisely regulated for reliable desoldering without damage to delicate circuitry.

DSPI	Desoldering Pump	$9.95

LOGIC PROBE

Compatible with all logic families using a 4 to 15V power supply. Thresholds automatically programmed. Visual indication of logic levels to show high, low, bad level or open circuit logic pulses.

- 10 N sec. pulse responses
- 120 K input impedence.
- Automatic resetting memory.
- Includes tip with protective cap & coiled cord.

PRB-1 **$36.95**

LOGIC PULSER

Superimposes a pulse train (20 pps) or a single pulse onto the circuit node under test without un-soldering IC's.

- Automatic polarity sensing
- 2 us pulse width
- Finger tip push button actuated
- Includes tip with protective cap & coiled cord.

PSL-1 **$48.95**

VACUUM VISE

Unique vacuum-based light duty vise for precision handling of small components and assemblies. Rugged ABS construction. 1½" (32mm) travel for maximum versatility. Also features screw lugs for permanent installation.

VV1	Vacuum Vice	$3.49

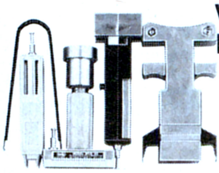
HOBBY-WRAP TOOL BW2630

- Auto-Indexing
- Anti-Overwrap
- Modified Wrap

Part No.	Description	Price
BW2630	Tool	$19.85
BT30	#30 Bit (not incl.)	3.95
BT2628	#28 Bit (not incl.)	7.95
BC1	Batteries & Charger	14.95

INSERTION/EXTRACTION TOOLS

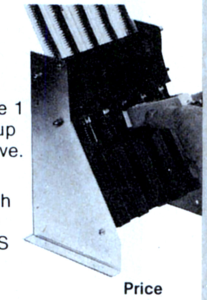
Part No.	Description	Price
INS1416	14-16 pin Inserter	$3.49
MOS1416	14-16 pin MOS Safe Inserter	7.95
MOS2428	24-28 pin MOS Safe Inserter	7.95
MOS40	40 pin MOS Safe Inserter	7.95
EX1	14-16 pin IC Extractor	1.49
EX2	24-40 pin IC Extractor	7.95



WK-7 IC INSERTION KIT

Complete IC Inserter/ Extractor Kit Individual Components (listed above) **$22.95**

IC DISPENSER



Allows IC's to be dispensed from their tube 1 at a time and picked up by insertion tools above.

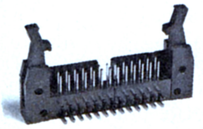
• Dispenses 8-42 pin IC's • Compatable with all IC carrying tubes • Use with WK7 for MOS safe insertion. •

Part No.	Description	Price
MDD1	1 Chan. Dispenser	$21.85
MDD5	5 Chan. Dispenser	83.43
MDD10	10 Chan. Dispenser	160.45

* *No Discount.

TOLL FREE ORDERING NUMBER 1-(800) 423-7144

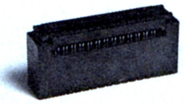
IDC CONNECTORS



RIGHT ANGLE HEADERS

Size	SOLDER TAIL Part No.	Price	WIRE WRAP Part No.	Price
10	IDH10SRB	$1.20	IDH10WRB	$2.60
20	IDH20SRB	1.90	IDH20WRB	4.15
26	IDH26SRB	2.75	IDH26WRB	5.35
34	IDH34SRB	3.75	IDH34WRB	6.25
40	IDH40SRB	3.75	IDH40WRB	7.35
50	IDH50SRB	4.75	IDH50WRB	9.20

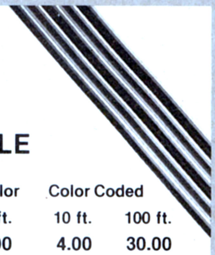
.1" Spacing. Mounts on PC Board & Mates with IDS Socket below. Ejector Bars - 4/1.00.



EDGE CARD CONNECTORS

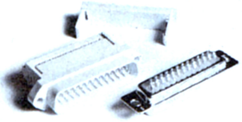
Size	Part No.	Price
10	IDE10B	$3.95
20	IDE20B	4.35
26	IDE26B	5.00
34	IDE34B	6.05
40	IDE40B	6.90
50	IDE50B	7.50

.1" Spacing. Crimps onto cable with ordinary vise & mates with standard .062" Card Edge.



RIBBON CABLE

Size	Solid Color 10 ft.	Solid Color 100 ft.	Color Coded 10 ft.	Color Coded 100 ft.
10	2.90	17.00	4.00	30.00
14	3.40	23.80	5.00	42.00
16	3.70	27.20	5.60	48.00
20	4.40	34.00	7.00	60.00
24	5.00	40.80	8.00	72.00
26	5.40	44.20	8.60	78.00
34	6.80	57.80	11.00	102.00
40	7.80	68.00	13.00	120.00
50	9.50	85.00	16.00	150.00



25 PIN "D" CONNECTORS

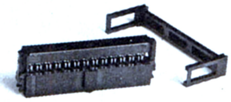
Solder Style	Part No.	Price
Male	DB25P	$2.95
Female	DB25S	3.95
Cover	DB25C	1.50
IDC Style		
Male	IDB25P	6.25
Female	IDB25S	6.60
Cover	IDB25C	1.60

Solder Style solders onto cable, IDC Style crimps onto cable with vise. 9, 15, 37 and 50 pin available also.

CABLE PLUGS

Size	Part No.	Price
14	IDP14B	$1.45
16	IDP16B	1.65
24	IDP24B	2.50
40	IDP40B	4.15

.1" Spacing. Crimps onto cable with ordinary vise & plugs into standard IC Socket.



SOCKETS

Size	Part No.	Price
10	IDS10B	$1.88
20	IDS20B	2.75
26	IDS26B	3.50
34	IDS34B	4.50
40	IDS40B	5.40
50	IDS50B	6.50

.1" Spacing. Crimps onto cable with ordinary vise & mounts to header sold above.

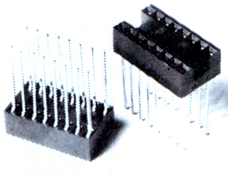
WIRE WRAP WIRE

#30 Wire Wrap Wire

Length	100/Bag	500/Bag	1K/Bag
2.5"	$1.38	$3.94	$6.81
3.0"	1.43	4.25	7.46
3.5"	1.51	4.57	8.11
4.0"	1.56	4.88	8.73
4.5"	1.63	5.21	9.39
5.0"	1.69	5.54	10.04
5.5"	1.74	5.92	10.69
6.0"	1.82	6.23	11.34
6.5"	2.11	7.08	12.99
7.0"	2.19	7.44	13.68
7.5"	2.29	7.78	14.40
8.0"	2.35	8.12	15.10
8.5"	2.40	8.46	15.80
9.0"	2.46	8.92	16.51
9.5"	2.53	9.15	17.22
10.0"	2.63	9.58	17.91

All lengths are overall, including 1" strip on each end. Choose from colors; Red, Blue, Black, Yellow, White, Green, Orange, and Violet.

WIRE WRAP SUPPLIES



Size	Part No.	Each	Tube
08	ICN083WBSG	.44	52x .39 = $20.28
14	ICN143WBSG	.53	30x .46 = $13.80
16	ICN163WBSG	.58	26x .50 = $13.00
18	ICN183WBSG	.78	23x .68 = $15.64
20	ICN203WBSG	1.00	21x .85 = $17.85
22	ICN224WBSG	1.07	19x .92 = $17.48
24	ICN246WBSG	1.09	17x1.09 = $15.98
28	ICN286WBSG	1.43	15x1.23 = $18.45
40	ICN406WBSG	1.85	10x1.60 = $16.00

Selective Plating provides gold in contact where it counts. 3-level wrap. Save by buying sockets by the tube. All gold available at ½¢/pin extra charge.

* * * No Discount

WIRE KITS

Kit No. 1 — $9.95

250	3"	100	4½"
200	3½"	100	5"
100	4"	100	6"

Kit No. 2 — $24.95

250	2½"	250	5"
500	3"	100	5½"
500	3½"	100	6"
500	4"	100	6½"
250	4½"	100	7"

Kit No. 3 — $34.95

250	2½"	500	4½"
500	3"	500	5"
500	3½"	500	5½"
500	4"	500	6"

Kit No. 4 — $59.95

500	2½"	1000	4½"
1000	3"	1000	5"
1000	3½"	1000	5½"
1000	4"	1000	6"

ORDERING INFORMATION

Prepaid orders over $50 shipped prepaid via UPS. All others add $3.00 for handling. VISA, MC, COD's and open account orders will be charged freight. $15 minimum order. $100 minimum open account order.

DISCOUNT SCHEDULE

Order	Amount
$15 - 99	Net
100 - 199	less 10%
200 - 499	less 15%
500 - 999	less 20%
1000 up	less 25%

Discount and the name of this magazine must be mentioned at time of order to get discount. Discount applies on all items except as noted, "No Discount."

Circle 335 on inquiry card.

16K Memory 4116-200ns 8/15.95

ALL MERCHANDISE 100% GUARANTEED!

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74LS00	.25	74LS164	**.95**
74LS01	.25	74LS165	**.95**
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74LS03	.25	74LS168	**1.75**
74LS04	.25	74LS169	**1.75**
74LS05	.25	74LS170	**1.75**
74LS08	.35	74LS173	**.80**
74LS09	.25	74LS174	**.95**
74LS10	.25	74LS175	**.95**
74LS11	.35	74LS181	**2.15**
74LS12	.35	74LS189	**9.95**
74LS13	.45	74LS190	**1.00**
74LS14	1.00	74LS191	**1.00**
74LS15	.35	74LS192	**.85**
74LS20	.25	74LS193	**.95**
74LS21	.35	74LS194	**1.00**
74LS22	.25	74LS195	**.95**
74LS26	.35	74LS196	**.85**
74LS27	.35	74LS197	**.85**
74LS28	.35	74LS221	**1.20**
74LS30	.25	74LS240	**.99**
74LS32	.35	74LS241	**.99**
74LS33	.55	74LS242	**1.85**
74LS37	.55	74LS243	**1.85**
74LS38	.35	74LS244	**.99**
74LS40	.25	74LS245	**1.90**
74LS42	.55	74LS247	**.76**
74LS47	.75	74LS248	**1.25**
74LS48	.75	74LS249	**.99**
74LS49	.75	74LS251	**1.30**
74LS51	.25	74LS253	**.85**
74LS54	.35	74LS257	**.85**
74LS55	.35	74LS258	**.85**
74LS63	1.25	74LS259	**2.85**
74LS73	.40	74LS260	**.65**
74LS74	.45	74LS266	**.55**
74LS75	.50	74LS273	**1.65**
74LS76	.40	74LS275	**3.35**
74LS78	.50	74LS279	**.55**
74LS83	.75	74LS280	**1.98**
74LS85	1.15	74LS283	**1.00**
74LS86	.40	74LS290	**1.25**
74LS90	.65	74LS293	**1.85**
74LS91	.89	74LS295	**1.05**
74LS92	.70	74LS298	**1.20**
74LS93	.65	74LS324	**1.75**
74LS95	.85	74LS352	**1.55**
74LS96	.95	74LS353	**1.55**
74LS107	.40	74LS363	**1.35**
74LS109	.40	74LS364	**1.95**
74LS112	.45	74LS365	**.95**
74LS113	.45	74LS366	**.95**
74LS114	.50	74LS367	**.70**
74LS122	.45	74LS368	**.70**
74LS123	.95	74LS373	**.99**
74LS124	2.99	74LS374	**1.75**
74LS125	.95	74LS377	**1.45**
74LS126	.85	74LS378	**1.18**
74LS132	.75	74LS379	**1.35**
74LS136	.55	74LS385	**1.90**
74LS137	.99	74LS386	**.65**
74LS138	.75	74LS390	**1.90**
74LS139	.75	74LS393	**1.90**
74LS145	1.20	74LS395	**1.65**
74LS147	2.49	74LS399	**1.70**
74LS148	1.35	74LS447	**.37**
74LS151	.75	74LS490	**1.95**
74LS153	.75	74LS668	**1.69**
74LS154	2.35	74LS669	**1.89**
74LS155	1.15	74LS670	**2.20**
74LS156	.95	74LS674	**9.65**
74LS157	.75	74LS682	**3.20**
74LS158	.75	74LS683	**2.30**
74LS160	.90	74LS684	**2.40**
74LS161	.95	74LS685	**2.40**
74LS162	.95	74LS688	**2.40**
74LS163	.95	74LS689	**2.40**

8200

8202	**45.00**
8205	**3.50**
8212	**1.85**
8214	**3.85**
8216	**1.80**
8224	**2.50**
8226	**1.80**
8228	**4.90**
8237	**19.95**
8238	**4.85**
8243	**4.45**
8250	**14.95**
8251	**5.40**
8253	**9.85**
8253-5	**9.85**
8255	**5.15**
8255-5	**5.25**
8257	**8.75**
8259	**6.90**
8272	**39.95**
8275	**29.95**
8279	**10.50**
8279-5	**10.50**
8282	**6.65**
8283	**6.65**
8284	**5.70**
8286	**6.65**
8287	**6.50**
8288	**25.00**
8289	**49.95**

6800

6800	**5.70**
6802	**11.95**
6809	**37.95**
6810	**4.60**
6820	**4.95**
6821	**3.45**
6828	**9.95**
6834	**16.95**
6840	**14.95**
6843	**42.95**
6844	**44.95**
6845	**29.95**
6847	**15.95**
6850	**3.50**
6852	**5.75**
6860	**10.95**
6862	**11.95**
6871	**25.95**
6875	**6.95**
6880	**1.75**

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8035	16.95
8039	19.95
8080A	3.95
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8086	99.95
8088	39.95
8155	11.95
8156	11.95
8185	29.95
8185-2	39.95
8741	39.95
8748	69.95
8755	49.95

Z80

Z80	**8.95**
Z80A	**6.00**
Z80B	**18.95**
Z80-PIO	**6.50**
Z80A-PIO	**5.95**
Z80-CTC	**5.95**
Z80A-CTC	**8.65**
Z80-DART	**15.25**
Z80A-DART	**18.75**
Z80-DMA	**17.50**
Z80A-DMA	**27.50**
Z80-SIO/0	**23.95**
Z80A-SIO/0	**28.95**
Z80-SIO/1	23.95
Z80A-SIO/1	**15.00**
Z80-SIO/2	**23.95**
Z80ASIO/2	**28.95**
Z80-SIO/9	**17.95**
Z80ASIO/9	**22.95**

T.V. CIRCUITS

MC1330	1.89
MC1350	1.29
MC1358	1.79
LM380	1.29
LM386	1.50
LM565	.99
LM741	.29
LM1310	2.90
LM1800	2.99
LM1889	2.49

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MISC.

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8T95	.99	TR1602	4.95
8T96	.99	IM6402	7.95
8T97	.99	1771	24.95
8T96	.99	1791	36.95
1488	.99	1793	49.95
1489	.99	UPD765	39.95
DM8131	2.95	8272	39.95
14411	9.95	74C923	5.95

We will beat any competitors prices

TRANSISTORS

PN2222	10/1.00	100/8.99
2N3904	10/1.00	100/8.99
2N3906	10/1.00	100/8.99
2N3055	.79	10/6.99
IN4148		25/1.00
IN4004		10/1.00

6502

6502	**6.95**
6502A	**12.95**
6504	**6.95**
6505	**8.95**
6520	**4.35**
6522	**9.95**
6532	**14.95**
6551	**11.85**

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EPROMS

1702	256 x 8	(1us)		**4.95**	**4.50**
2708	1024 x 8	(450ns)		**3.95**	**3.50**
2758	1024 x 8	(450ns)(5v)		**9.95**	**8.95**
TMS2516	2048 x 8	(450ns)(5v)		**7.95**	**6.95**
2716	2048 x 8	(450ns)(5v)		**5.50**	**5.00**
2716-1	2048 x 8	(350ns)(5v)		12.95	11.95
TMS2716	2048 x 8	(450ns)		9.95	8.95
TMS2532	4096 x 8	(450ns)(5v)		19.95	17.95
2732	4096 x 8	(450ns)(5v)		16.50	15.95

STATIC RAMS

				100pcs
2101	256 x 4	(450ns)	1.95	1.85
2102-1	1024 x 1	(450ns)	.89	.85
21L02-1	1024 x 1	(450ns)(LP)	1.29	1.15
2111	256 x 4	(450ns)	2.99	2.49
2112	256 x 4	(450ns)	2.99	2.79
2114	1024 x 4	(450ns)	8/17.95	2.10
2114L-2	1024 x 4	(200ns)(LP)	8/22.95	2.45
2114L-3	1024 x 4	(300ns)(LP)	**8/18.95**	**2.25**
2114L-4	1024 x 4	(450ns)(LP)	8/18.95	2.25
TMS4044-4	4096 x 1	(450ns)	3.49	3.25
TMS4044-3	4096 x 1	(300ns)	3.99	3.75
TMM2016	2048 x 8	(200ns)	CALL	
HM6116	2048 x 8	(200ns)	CALL	

DYNAMIC RAMS

				100pcs
4027	4096 x 1	(250ns)	2.50	2.00
4116-150	16,384 x 1	(150ns)	**8/18.95**	**1.95**
4116-200	16,384 x 1	(200ns)	**8/15.95**	**1.80**
4116-300	16,384 x 1	(300ns)	**8/14.95**	**1.75**
4164	65,536 x 1	(200ns)	CALL	

LP=LOW POWER

LINEAR

LM301V	.34	LM741V	.29
LM308V	.98	LM747	.79
LM309K	1.49	LM748V	.59
LM311	.64	LM1310	2.90
LM317T	1.95	MC1330V	1.89
LM317K	3.95	MC1350V	1.29
LM318	1.49	MC1358	1.79
LM323K	4.95	LM1414	1.59
LM324	.59	LM1458V	.69
LM337K	3.95	LM1488	.99
LM339	.99	LM1489	.99
LM377	2.29	LM1800	2.99
LM380	1.29	LM1889	2.49
LM386V	1.50	LM3900	.59
LM555V	.39	LM3909V	.98
LM556	.69	LM3914	3.95
LM565	.99	LM3915	3.95
LM566V	1.49	LM3916	3.95
LM567V	1.29	75451V	.39
LM723	.49	75452V	.39
LM733	.98	75453V	.39

T=TO-220 V=8 PIN K=TO-3

DIP SWITCHES

4 position	.85
5 position	.90
6 position	.90
7 position	.95
8 position	.95

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

LEDS

Jumbo Red	10/1.00
Jumbo Green	6/1.00
Jumbo Yellow	6/1.00
5082-7760 .43'CC	.79
MAN74 .3'CC	.99
MAN72 .3'CA	.99

VOLTAGE REG'S

7805T	.89	7905T	.99
7808T	.99	7912T	.99
7812T	.89	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	79L05	.79
78L05	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69	LM317K	3.95
LM309K	1.49	LM323K	4.95
LM317T	1.95	LM337K	3.95

T=TO-220 K=TO-3 L=TO-92

IC SOCKETS

	1-100	100pcs
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
ST = SOLDERTAIL		
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIREWRAP

master charge
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JDR MICRODEVICES, INC.
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San Jose, CA 95128
800-538-5000 • 800-662-6233 (Calif.)
408-247-4852

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2716 EPROMS 450NS (5V) 8/5.00 ea.

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CALL US FOR VOLUME QUOTES

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74C00	.35	74C374	2.75	4019	.45	4098	2.49
74C02	.35	74C901	.80	4020	.95	4099	1.95
74C04	.35	74C902	.85	4021	.95	14409	8.95
74C08	.35	74C903	.85	4022	1.15	14410	8.95
74C10	.35	74C905	10.95	4023	.35	14411	9.95
74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	2.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
74C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
74C195	2.25	4015	.95	4082	.30	80C95	.85
74C200	5.75	4016	.45	4085	.95	80C96	.95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
74C373	2.75	4018	.95	4093	.95	80C98	1.20

74S00 SERIES

74S00	.44	74S74	.69	74S163	3.75	74S258	1.49
74S02	.48	74S85	2.39	74S168	4.65	74S260	1.83
74S03	.48	74S86	1.44	74S169	5.44	74S274	19.95
74S04	.79	74S112	1.59	74S174	1.09	74S275	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S280	2.90
74S08	.48	74S114	1.50	74S181	4.47	74S287	4.75
74S09	.98	74S124	2.77	74S182	2.95	74S288	4.45
74S10	.69	74S132	1.24	74S188	3.95	74S289	6.98
74S11	.88	74S133	.98	74S189	14.95	74S301	6.95
74S15	.70	74S134	.69	74S194	2.95	74S373	3.45
74S20	.68	74S135	1.48	74S195	1.89	74S374	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S381	7.95
74S30	.48	74S139	1.25	74S197	4.25	74S387	5.75
74S32	.98	74S140	1.45	74S201	14.95	74S412	2.98
74S37	1.87	74S151	1.19	74S225	8.95	74S471	9.95
74S38	1.68	74S153	1.19	74S240	3.98	74S472	16.85
74S40	.44	74S157	1.19	74S241	3.75	74S474	17.85
74S51	.78	74S158	1.45	74S251	1.90	74S482	15.60
74S64	.79	74S161	2.85	74S253	7.45	74S570	7.80
74S65	1.25	74S162	3.70	74S257	1.39	74S571	7.80

PROMS

74S188	(82S23)	OC	32 x 8	3.95
74S287	(82S129)	TS	256 x 4	4.75
74S288	(82S123)	TS	32 x 8	4.45
74S387	(82S126)	OC	256 x 4	5.75
74S471		TS	256 x 8	9.95
74S472	(82S147)	TS	512 x 8	16.85
74S474	(82S141)	TS	512 x 8	17.85
74S570	(82S130)	OC	512 x 4	7.80
74S571	(82S131)	TS	512 x 4	7.80

7400 SERIES

7400	.19	74128	.55
7401	.19	74132	.45
7402	.19	74136	.50
7403	.19	74141	.65
7404	.19	74142	2.95
7405	.22	74143	2.95
7406	.22	74144	2.95
7407	.22	74145	.60
7408	.24	74147	1.75
7409	.19	74148	1.20
7410	.19	74150	1.35
7411	.25	74151	.65
7412	.30	74152	.65
7413	.35	74153	.55
7414	.55	74154	1.40
7416	.25	74155	.75
7417	.25	74156	.65
7420	.19	74157	.55
7421	.35	74159	1.65
7422	.29	74160	.85
7423	.29	74161	.70
7425	.29	74162	.85
7426	.29	74163	.85
7427	.29	74164	.85
7428	.45	74165	.85
7430	.19	74166	1.00
7432	.29	74167	1.95
7433	.45	74170	1.65
7437	.29	74172	5.95
7438	.29	74173	.75
7440	.19	74174	.89
7442	.49	74175	.89
7443	.65	74176	.89
7444	.69	74177	.75
7445	.69	74178	1.15
7446	.59	74179	1.75
7447	.69	74180	.75
7448	.69	74181	2.25
7450	.19	74182	.75
7451	.23	74184	2.00
7453	.23	74185	2.00
7454	.23	74186	18.50
7460	.23	74190	1.15
7464	.39	74191	1.15
7465	.39	74192	.79
7470	.35	74193	.79
7472	.29	74194	.85
7473	.34	74195	.85
7474	.35	74196	.79
7475	.49	74197	.75
7476	.35	74198	1.35
7480	.59	74199	1.35
7481	1.10	74221	1.35
7482	.95	74246	1.35
7483	.50	74247	1.25
7484	.50	74248	1.85
7485	.65	74249	1.95
7486	.35	74251	.75
7489	4.95	74259	2.25
7490	.35	74265	1.35
7491	.40	74273	1.95
7492	.50	74276	1.25
7493	.49	74279	.75
7494	.65	74283	2.00
7495	.55	74284	3.75
7496	.70	74285	3.75
7497	2.75	74290	.95
74100	1.00	74293	.75
74107	.30	74298	.85
74109	.45	74351	2.25
74110	.45	74365	.65
74111	.55	74366	.65
74116	1.55	74367	.65
74120	1.20	74368	.65
74121	.29	74376	2.20
74122	.45	74390	1.75
74123	.55	74393	1.35
74125	.45	74425	3.15
74126	.45	74426	.85
		74490	2.55

NEED FAST PARTS?

DYNAMIC RAMS			
4116	150NS	16K x 1	**8/18.95**
4116	120NS	16K x 1	8/29.95
STATIC RAMS			
2147	55NS	4K x 1	9.95
6116	150NS	2K x 8	CALL
6116	120NS	2K x 8	CALL
EPROMS			
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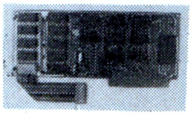
2732A	250NS	4K x 8	25.95
2732A-2	200NS	4K x 8	32.95
MPU's			
Z-80B	CPU	6mHz	**18.95**
Z-80B	CTC	6mHz	17.95
Z-80B	PIO	6mHz	17.95
68B00	CPU	2mHz	10.95
68B21	PIA	2mHz	12.95
68B50	ACIA	2mHz	12.95
8085A-2	CPU	5mHz	16.95

APPLE OWNERS

EXPAND YOUR 48K COMPUTER TO 64K

SUPER RAM • II

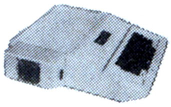


- PLUG IN SLOT Ø
- GOLD PLATED CONTACTS
- INCLUDES 5 JUMPER OPTIONS
- INCLUDES 5 RAM-ROM OPTIONS
- ENJOY THE BEST OF BOTH WORLDS
- 16K RAM (RANDOM ACCESS MEMORY)
- THIS IS SOPHISTICATED FIRMWARE
- EXPANDS YOUR 48K APPLE TO 64K OF PROGRAMMABLE MEMORY
- ELIMINATES THE NEED FOR APPLESOFT* OR INTEGER BASIC ROM CARD
- ALLOW YOU TO RUN APPLE'S NEW FORTRAN PACKAGE, ALSO PASCAL AND PILOT
- KEYBOARD CONTROL SELECTION OF RAM OR MOTHER BOARD ROM LANGUAGE
- INCLUDES INSTALLATION INSTRUCTIONS AND APPLICATIONS NOTES
- THE SOFTWARE DEVELOPED BY VARIOUS VENDORS FOR YOUR (64K) SHOULD NOW WORK AS THEY ADVERTISED
- THE MOST VERSATILE RAM EXPANSION ON THE MARKET TODAY

UNIQUE 1 YEAR WARRANTEE! $168.00

APPLE FAN

"COOL-IT"



- TAN COLOR
- SAVE DOWN TIME
- LONG LIFE MOTOR
- LOW NOISE IS A MUST
- SAVE REPAIR CHARGES
- INCREASES RELIABILITY
- CLIPS ON—NO HOLES OR SCREWS
- MINIMUM QUIETNESS IS DUE TO THE DRAW EFFECT OF AIR THROUGH YOUR COMPUTER AND A SPECIAL FAN AND MOTOR DESIGN
- THOSE EXTRA PLUG-IN CARDS CAN CAUSE EXTRA HEAT

HOW TO HOOK IT UP

1. Clip it on your APPLE
2. Unplug your 120V cable (you won't need it)
3. Plug short 120V cable from Super Fan II to the back of your computer
4. Plug the supply cable from Super Fan II to your 120V power source
5. Turn on the rocker switch and a built-in red ready light comes on
6. You are all set *"COOL IT"*

UNIQUE 1 YEAR WARRANTEE! $69.00

*APPLE IS A TRADEMARK OF APPLE COMPUTER INC.

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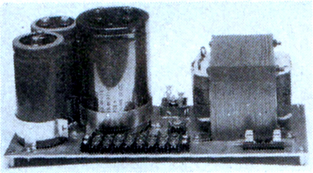
Circle 213 on inquiry card.

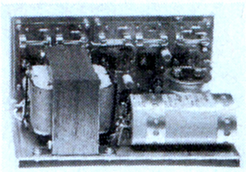
SUNNY LOW LOW COST

POWER SUPPLIES

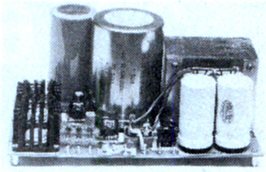
FOR S-100, FLOPPY DISKS.



KIT 1, 2 & 3 For S–100



R3 For Three 8" or 5¼" Disk Drives



S3 2 in 1 Unit for S–100 and two 8" or 5¼" Disk Drives. It fits most Disk System Mainframes.

S-100 POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	USED FOR	@ + 8 Vdc	@ – 9 Vdc	@ + 16 Vdc	@ – 16 Vdc	@ + 28 Vdc	SIZE W × D × H	PRICE
KIT 1	15 CARDS SOURCE	15A		2.5A	2.5A		12" × 5" × 4⅞"	52.95
KIT 2	SYSTEM SOURCE	25A		3A	3A		12" × 5" × 4⅞"	59.95
KIT 3	DISK SYSTEM	15A	1A	2A	2A	4A	14" × 6" × 4⅞"	67.95

DISK DRIVE POWER SUPPLY "R3" REGULATED, OPEN FRAME, ASSY. & TESTED 67.95

SPECS: + 5V @ 5A OVP, –5V @ 1A + 24V@ 5A, SHORTS PROTECT. 2 SIZES AVAIL., 1.) 9" (W) × 6¼" (D) × 4⅜" (H), 2) 9" (W) × 4⅞" (D) × 5¼" (H)
OPTION: 1.) REPLACE + 24V BY + 12V, 2.) FOR SIZE 1 ONLY, ADD ± 12V @ 1A, AT AN ADDITIONAL $12.00
IDEAL FOR THREE 8" or 5¼ FLOPPY DISK DRIVES, SUCH AS SHUGART 801/851, SIEMANS FDD 100-8/200–8 OR 100–5 ETC.

DISK SYSTEM PWR SUPPLY "S3" OPEN FRAME, ASSY. & TESTED. COMPACT SIZE: 10"(W) × 6" (D) × 5" (H) 92.95

REGULATED OUTPUTS FOR DISK DRIVES: +5V @ 4A, –5V @ 1A, +24V @ 4A (OR + 12V @ 4A). SHORTS PROTECT
UNREGULATED OUTPUTS FOR S–100: +8V @ 14A, ± 16V @ 3A. (OPTION: ADD OVP FOR +5V, ADD $5.00)
A COMPLETE UNIT FOR DISK SYSTEM WITH THE MAINFRAME CONTAINING 12 SLOTS & TWO 8" or 5¼" DISK DRIVES

POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

ITEM	PRIMARY	SECONDARY #1	SECONDARY #2	SECONDARY #3	SIZE W × D × H	PRICE
T_1	110/120	2 × 8 Vac, 15A	28 Vac, CT, 2.5A		3¾" × 3⅝" × 3⅛"	**21.95**
T_2	110/120	2 × 8 Vac, 25A	28 Vac, CT, 3.5A		3¾" × 4⅜" × 3⅛"	**27.95**
T_3	110/120	2 × 8 Vac, 15A	28 Vac, CT, 2.5A	48 Vac, CT, 2A	3¾" × 4⅜" × 3⅛"	**29.95**
T_4	110/120	2 × 8 Vac, 6A	28 Vac, CT, 1.5A	48 Vac, CT, 3A	3¾" × 3⅝" × 3⅛"	**22.95**
T_5	110/120	2 × 8 Vac, 6A	28 Vac, CT, 2A		3" × 3" × 2½"	**14.95**

SHIPPING For each power supply $5.50 in Calif., $7.50 in other states, $14.00 in Canada. For each Transformer $5.00 in all States, $10.00 in Canada. Calif. Residents add 6% Sales Tax.

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TORRANCE, CA 90510
TELEX: 830-5010
ANSWER BACK FOR TELEX SUNYCO TRUC

SUNNY INTERNATIONAL
(TRANSFORMERS MANUFACTURER)
(213) 328-2425 MON-SAT 9-6

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3 ALTERNATIVE INTERFACES FOR THE TRS-80

COMM-80™

Featured in May/June '80 BYTE

- RS-232-C port (50-19.2K baud) software/hardware selectable
- Centronics printer port 8-bit
- connects to keyboard or E. I.
- chain up to 16 units
- use with E. I. for 2nd printer
- includes terminal software
- only $179.95 complete

ALL INTERFACES ARE RADIO SHACK HARDWARE AND SOFTWARE COMPATIBLE AND CARRY A 60 DAY WARRANTEE INCLUDING PARTS AND LABOR. ALL UNITS INCLUDE USER'S MANUAL, POWER SUPPLY & AUXILIARY TRS-BUS CONNECTOR FOR FUTURE EXPANSION.

DISK-80™

Featured in March '81 BYTE

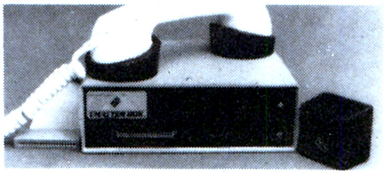
- disk controller (4 drives)
- hardware data separator
- includes 16K of RAM provision for additional 16K
- buffered TRS-bus connector
- real-time clock
- printer port (optional)

ASSEMBLED & TESTED
with 16K of RAM $329.95
Centronics Printer
Port add .... $ 50.00
with 32K RAM add... $ 50.00
DISK-80 pc board..... $ 48.00
Printer/Power Supply
pc board .... $ 16.00
Complete Kit with 16K
RAM and Printer Port . $275.00

Dealer inquiries invited.

TRS-80 is trademark of Tandy Corp.

CHATTERBOX™



Featured in Aug. '80 BYTE

- 300 baud originate modem
- Centronics printer port 8-bit
- RS-232-C port (50-19.2K baud)
- connects to keyboard or E. I.
- received data automatically routed to printer ports
- includes terminal software
- only $279.95 complete

Call 1-800-645-3479, in N.Y. 1-516-374-6793

or write: The MicroMint Inc.
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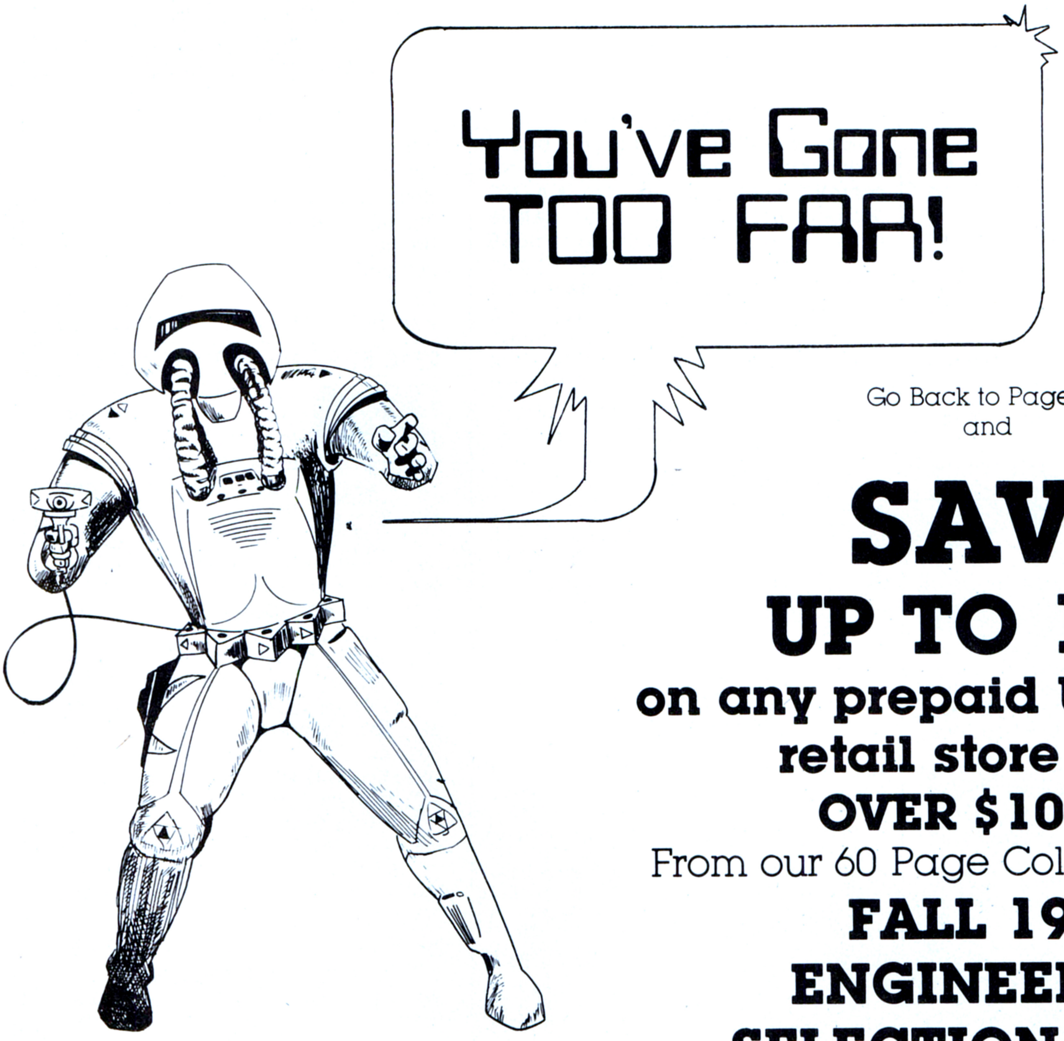
Woodmere, NY 11598

MICRO MINT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☐	**$500 & UP**	**Deduct $ 10%**

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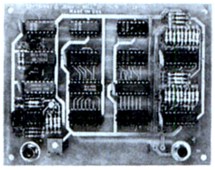
Circle 350 on inquiry card.

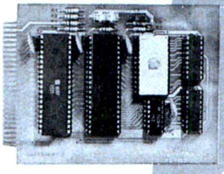
A-D & D-A CONVERTER



JBE one channel A-D & D-A Converter can be used with any system having parallel ports • Interfaces with JBE Parallel I/O Card • D-A conversion time — 5 µs • A-D conversion time — 20 µs • Uses JBE 5V power supply • Parallel inputs & outputs include 8 data bits, strobe lines & latches • Analog inputs & outputs are medium impedance 0 to 5 volt range.

79-287 ASSM. **$79.95**
Bare Board **$39.95** Kit **$59.95**

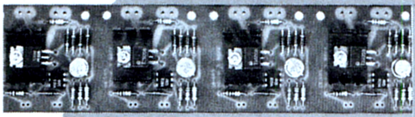
6502 MICROCOMPUTER



JBE's 4½x3¼ dedicated controller features: • 1024 bytes RAM (two 2114s) • 2048 bytes EPROM (2716) • Uses one 6522 VIA (comp. doc. incl.) • Interfaces with JBE Solid State Switches & A-D & D-A Converter • Uses JBE 5V power supply • 2716 EPROM available separately (2716 can be programmed with an Apple II & JBE EPROM Programmer & Parallel Interface) • 50 pin connector included in kit & assm.

80-153 ASSM. **$110.95**
Bare Board **$49.95** Kit **$ 89.95**

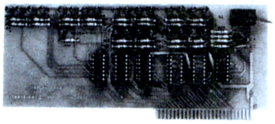
SOLID STATE SWITCH



Your computer can control power to your printer, lights, stereo & any 120VAC appliances up to 720 watts (6 amps at 120VAC). Input 3 to 15VDC • 2-14MA TTL compatible • Isolation — 1500V • Non zero crossing • Comes in 1 or 4 channel version.

79-282-1 ASSM. **$13.95**
Bare Board **$6.95** Kit **$10.95**
79-282-4 ASSM. **$49.95**
Bare Board **$24.95** Kit **$39.95**

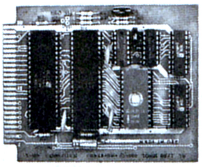
APPLE II DISPLAY BOARD



• Has run-stop, single step switch • Has 16 address LEDs, 8 data LEDs & 1 RDY LED • All lines are buffered.

80-144 ASSM. **$49.95**
Bare Board **$25.95** Kit **$42.95**

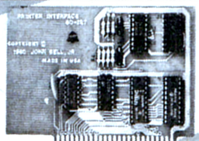
Z80 MICROCOMPUTER



JBE's 4-1/8"x3-1/4" single board dedicated computer is designed for control functions. It features: • A Z80 Microprocessor software compatible with the Z80, 8080 & 8085 Microprocessors • Uses a Z80 PIO chip for I/O which has 2 independent 8 bit bidirectional peripheral interface ports with handshake & data transfer control • Uses one 2716 EPROM (2K) & two 2114 RAM memories (1K) • Single 5V power supply at 300MA req. • Clock frequency is 2MHz, RC controlled • Board comes with complete doc. • 50 pin connector is included • 2716 EPROM available separately.

80-280 ASSM. **$129.95**
Bare Board **$49.95** Kit **$119.95**

PRINTER INTERFACE



JBE Parallel Printer Interface interfaces your Apple II® to Centronics® compatible printers. This 3" x 4" board features: on board ROM compatible with Integer Basic, Applesoft® and Pascal® • Has one 8 bit parallel latched output port with selectable positive or negative strobe and one bit input selectable for Ready or Ready • Cable and Connectors available separately.

80-297 ASSM. **$79.95**
Kit **$69.95**
4 ft. Std. Dip Jumpers 16 pin **$ 4.25**
Champ Connector **$ 9.95**

POWER SUPPLIES

• Use wall transformers for safety • Protected against short circuit and thermal breakdown.

5 VOLT POWER SUPPLY

Rated at 5V 500MA • Operates JBE A-D & D-A Converter, Z80 & 6502 Microcomputers, 8085 & 8088 Microcomputers.

80-160 ASSM. **$20.95**
Bare Board **$8.95** Kit **$16.95**

± 12 VOLT POWER SUPPLY

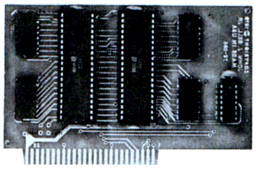
Rated at ± 12V 120MA • Can be used as a single 24V power supply • Ideally suited to OP-AMP experiments.

80-161 ASSM. **$22.95**
Bare Board **$8.95** Kit **$18.95**

ICS

6502	**$9.95**
6522	**$9.95**
Z80 CPU	**$9.95**
Z80 PIO	**$9.95**
2716	**$14.95**
2716 Programmed	**$19.95**

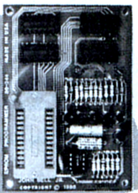
6522 APPLE II INTERFACE



• Interfaces printers, synthesizers, keyboards, JBE A-D & D-A Converter & Solid State Switches • Has handshaking logic, two 6522 VIAs & a 74LS05 for timing • Inputs & outputs are TTL compatible.

79-295 ASSM. **$69.95**
Bare Board **$39.95** Kit **$59.95**

2716 EPROM PROGRAMMER



JBE 2716 EPROM Programmer was designed to program 5V 2716 EPROMS • It can also read 2716s. It interfaces to the Apple II using JBE Parallel I/O Card & four ribbon cable connectors • An LED indicates when power is being applied to the EPROM • A textool zero insertion force socket is used for the EPROM • Comes with complete doc. for writing and reading in the Apple II or Apple II+ • Cables available separately.

80-244 ASSM. **$49.95**
Bare Board **$24.95** Kit **$39.95**
2 Ft. Ribbon Cable **$ 4.25**

BARE BOARDS

APPLE II EXTENDER BOARD

3½" x 2½". Price includes 50 pin Connector.

80-143 **$12.95**

8085 3 CHIP SYSTEM

State-of-the-art system using an 8085, 8156 & either an 8355 or 8755 • Instruction set 100% upward compatible with 8080A.

Bare Board **$24.95**

8088 5 CHIP SYSTEM

An 8086 family microcomputer system using an 8088 CPU, 8284, 8155, 8755A & an 8185.

Bare Board **$29.95**

CRT CONTROLLER

This intelligent CRT Controller uses an 8085A CPU & an 8275 Integrated CRT Controller. It features: • 25 lines (80 Char./line) • 5x7 dot matrix • Upper & lower case • two 2716s (controller & char. generator) • serial interface RS232 & TTL • baud rates of 110, 150, 300, 600, 1200, 2400, 4800 & 9600 • keyboard scanning system • unencoded keyboard is req'd • uses +5V & ± 12V power supplies • Doc. includes program listing & composite video circuit.

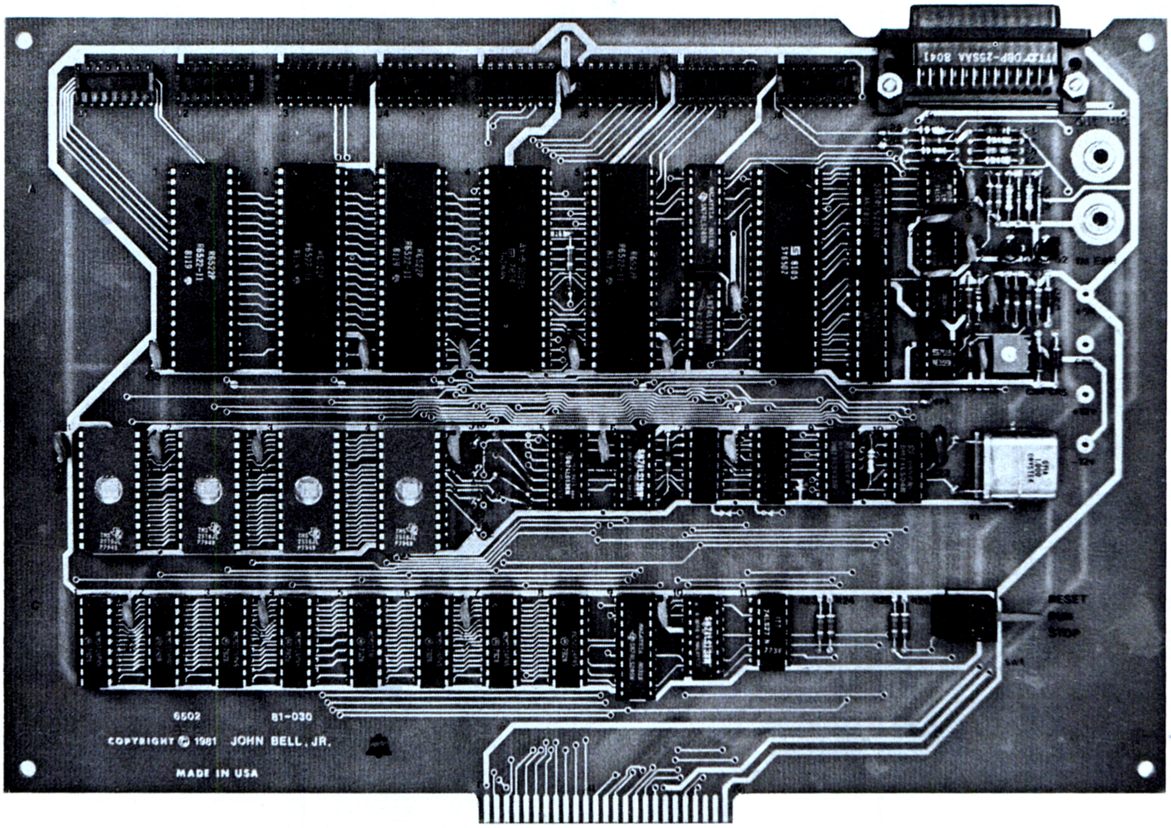
Bare Board only (Doc. incl.) **$39.95**
Programmed 2716s each **$19.95**

JOHN BELL ENGINEERING, INC.

ALL PRODUCTS ARE AVAILABLE FROM **JOHN BELL ENGINEERING** • P.O. BOX 338
REDWOOD CITY, CA 94064 • ADD SALES TAX IN CALIFORNIA • ADD 5% SHIPPING & HANDLING
10% OUTSIDE U.S.A.
(415) 367-1137

MC

VISA



JBE I MICROCOMPUTER

John Bell Engineering's low-cost JBE I Microcomputer - based on the powerful 6502 processor - is specifically designed for WORK, LEARNING, DEVELOPMENT AND CONTROL. The JBE I has a unique combination of features:

- *6502 Microprocessor*
- *4 6522 VIAs (8 parallel I/O ports)*
- *1 AY5-1013 (UART serial port)*
- *Cassette Interface*
- *4K 2114 RAM Memory*
- *8K or 16K EPROM Memory*
- *Monitor and Tiny Basic*
- *Variety of Support Cards*

- *Use your JBE I to PROGRAM 2716s, TALK to you, CONTROL the world.*
- *JBE I interfaces with JBE's EPROM Programmer, Parallel Input Speech Synthesizer, A-D & D-A Converter and Solid State Switches.*
- *Save your programs easily and accurately using the cassette interface.*
- *Use your JBE I for:*

CONTROL

- *Home security and lighting systems*
- *Irrigation systems*
- *Model Tranis*
- *Solar heating and power systems*

DEVELOPMENT

- *Software for work and home*
- *Learning aids for children at home and school*
- *Development system for JBE 6502 Microcomputer*

LEARNING

- *Microcomputer Technology*
- *Machine language and Basic programming*
- *The three R's for children*

JBE I is available fully populated, partially populated or as a bare board for OEM and the dedicated hobbyist:

The fully populated version includes:

6502 CPU
4 6522 VIAs
AY5-1013
4K RAM
Monitor EPROM
Tiny Basic EPROM

Partially Assembled Version includes:

6502 CPU
1 6522 VIA
AY5-1013
1K RAM
Monitor EPROM

All versions include complete documentation. For information write: John Bell Engineering, P.O. Box 338, Redwood City, CA 94064. (415) 367-1137. OEM Pricing available.

FOR MASTER CHARGE, VISA AND C.O.D. ORDERS CALL (415) 367-1137 OR SEND CHECK TO THE ABOVE ADDRESS, DEPT. JI. PLEASE INCLUDE 5% FOR SHIPPING AND HANDLING INSIDE USA AND 10% OUTSIDE USA.

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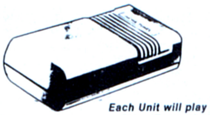
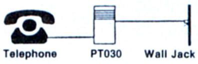
MC14419	7.95
MC14433	15.95
MC14538	2.49
MC14541	1.95

Phone Tunes

As Seen on "Good Morning America"

Replaces the Telephone Ringer Bell with a Selection of 30 Familiar Tunes





Each Unit will play any of the following tunes:

- Rule Brittania
- O Canada
- Colonel Bogey
- Westminister Chimes
- Mexican Hat Dance
- Twinkle, Twinkle Little Star
- Deutschlandlied
- God Save the Queen
- Close Encounters
- Happy Birthday
- Wedding March
- Jingle Bells
- Auld Lang Syne
- Soldiers Chorus
- Sailor's Hornpipe
- Charge!
- Greensleeves
- Lorelei
- Eyes of Texas
- Star Spangled Banner
- Oranges and Lemons
- Wilhelmus
- Mozart Sonata
- Pomp & Circumstance
- William Tell Overture
- Bach Toccata in D Minor
- Shave and a Haircut
- Blue Danube Waltz
- Beethoven's 5th
- La Marseillaise

FEATURES

Replaces monotonous telephone ringer bell. Easily connects to any standard telephone. Can be used alongside regular phone or replace a remote ringer elsewhere in building or outside. FCC approved. Can be used on any telephone system — worldwide. Use a different tune to identify extension phones. Microprocessor controlled. Adjustable volume control and variable tune speed control. Operates on two 9-volt batteries or AC Adapter (not included).

PT030 Phone Tunes $49.95
AD30 AC Adapter $8.95

DISCRETE LEDS

XC556R	.200"	red	5/$1
XC556G	.200"	green	4/$1
XC556Y	.200"	yellow	4/$1
XC556C	.200"	clear	4/$1
XC22R	.200"	red	5/$1
XC22G	.200"	green	4/$1
XC22Y	.200"	yellow	4/$1
MV10B	.170"	red	4/$1
MV50	.085"	red	6/$1
XC209R	.125"	red	5/$1
XC209G	.125"	green	4/$1
XC209Y	.125"	yellow	4/$1
XC526R	.185"	red	5/$1
XC526G	.185"	green	4/$1
XC526Y	.185"	yellow	4/$1
XC526C	.185"	clear	4/$1

.200(TI¾) Red/Green

Diffused Bi-Color LED

Part No.	1-99	100+
XC5491	.79	.69

XC556 RED LED, METAL MTG. HDW. 2-6" LEADS.

RL-2 . . $.39 ea. or 3/$1.00

DISPLAY LEDS

C.A. — Common Anode
D.D. — Double Digit
C.C. — Common Cathode
RHD — Right Hand Decimal

Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95
MAN 2	5x7 D.M.—red	.300	4.95
MAN 3	C.C.—red	.125	.25
MAN 52	C.A.—green	.300	.99
MAN 54	C.C.—green	.300	.99
MAN 71	C.A.—red	.300	.75
MAN 72	C.A.—red	.300	.75
MAN 74	C.C.—red	.300	1.25
MAN 82	C.A.—yellow	.300	.49
MAN 84	C.C.—yellow	.300	.99
MAN 3620	C.A.—orange	.300	.49
MAN 3630	C.A.—orange ± 1	.300	.99
MAN 3640	C.C.—orange	.300	.99
MAN 4610	C.A.—orange	.400	.99
MAN 6610	C.A.—orange—DD	.560	.99
MAN 6630	C.A.—orange ± 1	.560	.99
MAN 6640	C.C.—orange—DD	.560	.99
MAN 6650	C.C.—orange ± 1	.560	.99
MAN 6660	C.A.—orange	.560	.99
MAN 6710	C.A.—red—DD	.560	.99
MAN 6740	C.C.—red—DD	.560	.99
MAN 6750	C.C.—red ± 1	.560	.99
DLO304	C.C.—orange	.300	1.25
DLO307	C.A.—orange	.300	1.25
DLG500	C.C.—green	.500	1.25
DLG507	C.A.—green	.500	1.25
DL704	C.C.—red	.300	1.25
DL707	C.A.—red	.300	1.25
DL728	C.C.—red	.500	1.49
DL741	C.A.—red	.600	1.25
DL747	C.A.—red	.600	1.49
DL750	C.C.—red	.600	1.49
DLO847	C.A.—orange	.800	1.49
DLO850	C.C.—orange	.800	1.49
DL33B	C.C.—red	.110	.35
FND358	C.C. ± 1	.357	.99
FND357	C.C.	.357	.75
FND500	C.C. (FND503)	.500	.99
FND507	C.A. (FND510)	.500	.99
HDSP-3401	C.A.—red	.800	1.50
HDSP-3403	C.C.—red	.800	1.50
HDSP-3406	C.C. red ±1	.800	1.50
5082-7751	C.A., R.H.D.—red	.430	1.25
5082-7760	C.C., R.H.D.—red	.430	1.25
5082-7300	4x7 Numeric (RHD)	.600	22.00
5082-7302	4x7 Numeric (LHD)	.600	22.00
5082-7340	4x7 Hxdcl. (0-9/A-F)	.600	22.50
4N28	Photo Xsistor Opto-Isol.		.69
LIT-1	Photo Xsistor Opto-Isol.		.69
MOC3010	Optically Isol. Triac Driver		1.25

SOCKETS — Test TEXTOOL Sockets — RECEPTACLES

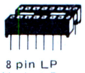
ZERO INSERTION FORCE

- ★ Nickel Boron Plating
- ★ G.F. PSF Plastic Body
- ★ For testing IC's

Part No.	Pins	Price
214-3339	14 pin	5.95
216-3340	16 pin	6.49
218-3341	18 pin	7.95
220-3342	20 pin	8.95
222-3343	22 pin	9.95
224-3344	24 pin	9.75
228-3345	28 pin	11.95
240-3346	40 pin	12.95

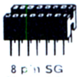
- ★ Nickel Boron Plating
- ★ G.F. PSF Plastic Body
- ★ Wire Wrap Contacts

Part No.	Pins	Price
214-3592	14 pin	9.75
216-3593	16 pin	9.95
218-3594	18 pin	10.95
220-3595	20 pin	11.95
222-3596	22 pin	12.95
224-3597	24 pin	12.75
228-3598	28 pin	13.95
240-3599	40 pin	15.95



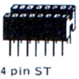
LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61



SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45



SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50pcs.	$1.95
ASST. 2	5ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50pcs.	$1.95
ASST. 3	5ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K 1.2K 1.5K 1.8K 2.2K 2.7K	50pcs.	$1.95
ASST. 4	5ea.	3.3K 3.9K 4.7K 5.6K 6.8K 8.2K 10K 12K 15K 18K	50pcs.	$1.95
ASST. 5	5ea.	22K 27K 33K 39K 47K 56K 68K 82K 100K 120K	50pcs.	$1.95
ASST. 6	5ea.	150K 180K 220K 270K 330K 390K 470K 560K 680K 820K	50pcs.	$1.95
ASST. 7	5ea.	1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1.50 Insurance

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PRICES SUBJECT TO CHANGE

11/81

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39
74C02	.39
74C04	.39
74C08	.39
74C10	.39
74C14	.75
74C20	.39
74C30	.39
74C42	1.39
74C48	1.95
74C73	.79
74C74	.79
74C85	1.95
74C86	.99
74C89	6.95
74C90	1.29
74C93	1.29
74C95	1.59
74C107	1.89
74C151	2.95
74C154	3.95
74C157	2.25
74C160	1.69
74C161	1.60
74C162	1.49
74C163	1.69
74C164	1.59
74C173	1.39
74C174	1.39
74C175	1.19
74C192	1.69
74C193	1.69
74C195	1.59
74C221	1.95
74C240	2.25
74C244	2.25
74C373	2.49
74C374	2.59
74C901	.69
74C903	.69
74C911	10.95
74C912	10.95
74C915	1.69
74C917	10.95
74C922	5.49
74C923	5.75
74C925	7.50
74C926	7.50
80C95	.79
80C97	.79

LINEAR

LH0002CN	6.85
LM10CLH	4.50
LM11CLH	4.75
LH0070-OH	4.95
TL071CP	.79
TL072CP	1.39
TL074CN	2.49
LH0082CD	35.80
TL082CP	1.19
TL084CN	2.19
LH0094CD	36.80
LM300H	.99
LM301CN	.35
LM302H	1.95
LM304H	1.95
LM305H	.99
LM307CN	.45
LM308CN	1.00
LM309H	1.95
LM309K	1.25
LM310CN	1.75
LM311/CN	.90
LM312H	2.49
LM317MP	1.15
LM317T	1.75
LM317K	3.95
LM318CN	1.95
LM319N	1.95
LM320K-5	1.35
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.25
LM320T-12	1.25
LM320T-15	1.25
LM323K	5.95
LM324N	.99
LM329DZ	.65
LM331N	3.95
LM334Z	1.30
LM335Z	1.40
LM336Z	1.75
LM337T	1.95
LM337MP	1.15
LM338K	6.95
LM339N	.99
LM340K-5	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340T-5	1.25
LM340T-12	1.25
LM340T-15	1.25
LM341P-5	.75
LM341P-12	.75
LM341P-15	.75
LM342P-5	.69
LM342P-12	.69
LM342P-15	.69
LM348N	1.25
LM350K	5.75
LF351N	.60
LF353N	1.00
LF355N	1.10
LF356N	1.10
LM358N	1.00
LM359N	1.79
LM370N	4.49
LM373N	3.25
LM377N	2.95
LM380N	1.25
LM381N	1.95
LM382N	1.79
LM384N	1.95
LM386N-3	1.29
LM387N	1.45
LM389N	1.35
LM392N	.69
LF398N	4.00
LM399H	5.00
TL494CN	4.49
TL496CP	1.75
NE510A	6.00
NE529A	4.95
NE531H	3.95
NE536H	6.00
NE540H	6.00
NE544N	4.95
NE550A	1.30
NE555V	.39
LM556N	.99
NE564N	3.95
LM565N	1.25
LM566CN	1.95
LM567V	1.25
NE570N	4.95
LM702H	.79
LM703CN	.89
LM709N	.29
LM710N	.79
LM711N	.79
LM723N	.69
LM733N	1.00
LM739N	1.19
LM741CN	.35
MC1741SCG	3.00
LM747N	.79
LM748N	.59
LM1014N	2.75
LM1310N	1.95
LM1458CN	.59
LM1488N	1.25
LM1489N	1.25
LM1496N	1.95
LM1556V	1.75
LM1800N	2.95
LM1871N	5.49
LM1872N	5.49
LM1877N-9	3.25
LM1889N	3.20
LM1896N	1.75
LM2002T	1.49
LM2877P	2.05
LM2878P	2.25
LM2896P-1	2.25
LM3189N	2.95
LM3900N	.69
LM3905CN	1.25
LM3909N	1.15
LM3914N	3.95
LM3915N	3.95
LM3916N	3.95
RC4136N	1.25
RC4151NB	3.95
RC4194TK	6.95
RC4195TK	5.49
LM4500A	3.25
ICL8038B	4.95
LM13080N	1.29
LM13600N	1.49
75138N	1.95
75450N	.89
75451CN	.39
75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+
10 pf	.08	.06	.05
22 pf	.08	.06	.05
47 pf	.08	.06	.05
100 pf	.08	.06	.05
220 pf	.08	.06	.05
470 pf	.08	.06	.05
.001µF	.08	.06	.05
.0047µF	.08	.06	.05
.01µF	.08	.06	.05
.022µF	.09	.07	.06
.047µF	.09	.07	.06
.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07
.0022mf	.12	.10	.07
.0047mf	.12	.10	.07
,01mf	.12	.10	.07
.022mf	.13	.11	.08
.047mf	.21	.17	.13
.1mf	.27	.23	.17
.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29
.15/35V	.39	.34	.29
.22/35V	.39	.34	.29
.33/35V	.39	.34	.29
.47/35V	.39	.34	.29
.68/35V	.39	.34	.29
1.0/35V	.39	.34	.29
1.5/35V	.41	.37	.29
2.2/35V	.51	.45	.34
3.3/25V	.53	.47	.37
4.7/25V	.63	.56	.45
6.8/25V	.79	.69	.55
15/25V	1.39	1.25	.95
22/6V	.79	.69	.55

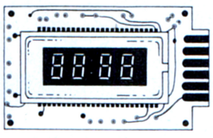
MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+
.47/50V	.16	.14	.10
1.0/50V	.19	.16	.12
3.3/50V	.17	.15	.11
4.7/25V	.18	.15	.11
10/25V	.18	.15	.11
10/50V	.19	.16	.12
22/25V	.19	.16	.12
22/50V	.24	.20	.18
47/25V	.25	.21	.19
47/50V	.29	.25	.23
100/25V	.28	.24	.22
100/50V	.41	.37	.34
220/25V	.39	.34	.33
220/50V	.49	.45	.41
470/25V	.54	.49	.45
1000/16V	.79	.69	.61
2200/16V	.89	.79	.69

Radial	1-99	100-499	500+
.47/25V	.15	.13	.12
.47/50V	.16	.14	.13
1.0/16V	.15	.13	.12
1.0/25V	.16	.14	.13
1.0/50V	.17	.15	.14
4.7/16V	.15	.13	.12
4.7/25V	.16	.14	.13
4.7/50V	.17	.15	.14
10/16V	.15	.13	.12
10/25V	.16	.14	.13
10/50V	.17	.15	.14
47/50V	.25	.21	.19
100/16V	.21	.17	.14
100/25V	.25	.23	.21
100/50V	.37	.34	.31
220/16V	.25	.21	.19
470/25V	.35	.31	.27

Circle 212 on inquiry card.

National Semiconductor Clock Modules



12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal timebase. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete – just add switches and lens.

MA1003 Module (3.05"L×1.75"H×.98"D) . **$16.95**

CLOCK MODULES

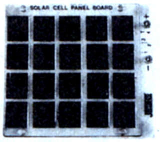
MA1023	.7" Red Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Red Digital LED Clock/Timer	6.95
MA1002	.5" Red Digital LED Clock & Xformer	9.95
MA1010	.8" Red Digital LED Clock	7.95
MA1032	CBA .5" Digital LCD Clock	17.95
MA1043	.7" Green Digital LED Clock	8.95

TRANSFORMERS

102-P20	Xformer for MA1023, 1043 & 5036 Mods.	3.49
102-P22	Xformer for MA1026 Clock Modules	3.49
102-P24	Xformer fc MA1010 Clock Modules	3.49

NEW!

Sun Power Your Electronics!
SOLAR CELL PANEL KIT

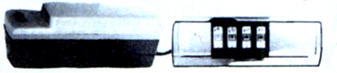


Features:
- **Output: 10VDC, to 100mA in Series 5VDC, to 200mA in Parallel**
- **Panel may be easily connected for Series or Parallel out**
- **Over 11 square inches of active cell surface**
- **Voltage line tap @ 0.5V increments**
- **Provision for charging batteries**
- **Overall panel size: 4¾"L x 4½"H x ½"D**

The JE305 Solar Cell Panel Kit contains 20 each solar cells. On the panel board are power line taps which allow the user to select voltages (one voltage at a time) from 0.5VDC to 10VDC. The applications of each panel can be further expanded by coupling additional panels in series for more voltage or in parallel for more current. The premium grade solar cells provide the current necessary for the operation of most portable transistor radios, small battery powered cassette tape players and unlimited experimental solar projects.

JE305 . . . . $39.95

EPROM Erasing Lamp

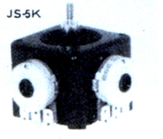


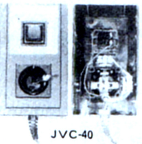
- **Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.**
- **Erases up to 4 chips within 20 minutes.**
- **Maintains constant exposure distance of one inch.**
- **Special conductive foam liner eliminates static build-up.**
- **Built-in safety lock to prevent UV exposure.**
- **Compact – only 7-5/8" x 2-7/8" x 2"**
- **Complete with holding tray for 4 chips.**

UVS-11EL Replacement Bulb $16.95

UVS-11E $79.95

JOYSTICKS





JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case . . .	$4.95

ALLIGATOR CLIP TEST LEADS

15" LONG LEADS

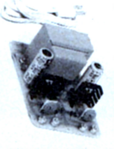
Heavy-duty leads, color coded. Insulated alligator clip on each end. 15" long. Two each black, red, blue, white and yellow.

#ALCP (10 per pack) . . . . $2.95/pkg.

NEW!

JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.



FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) . .	**$14.95**
JE205 Adapter Brd. (to JE200) ±5, ±9 & ±12V.	**$12.95**
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp.	**$19.95**

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A·	CPU	4.95
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	6.95
DP8253	Prog. Interval Timer	8.95
DP8255	Prog. Peripheral I/O (PPI)	5.95
DP8257	Prog. DMA Control	9.95
DP8259	Prog. Interrupt Control	9.95
DP8275	Prog. CRT Controller	39.95
DP8279	Prog. Keyboard/Display Interface	9.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95
DP8310	Octal Latched Peripheral Driver	5.25
DP8311	Octal Latched Peripheral Driver	5.25

6800/6800 SUPPORT DEVICES

MC6800	MPU	7.95
MC6802CP	MPU with Clock and RAM	14.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	17.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	11.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	13.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MCS6502	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	7.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	9.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	9.95
TMS9900JL	MPU—16-Bit	39.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402N	256-Bit Dynamic	2.95
MM5013N	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	1.95
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	1.95
2518N	Hex 32-Bit Static	3.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Band Filter	19.95
AF122-1CJ	Touch Tone High Band Filter	19.95
LM308CH	Super Gain Op Amp	1.15
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	6.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	3.25
2114L	1024x4 Static 450ns Low Power	3.49
2114-2	1024x4 Static 200ns	3.95
2114L-2	1024x4 Static 200ns Low Power	4.95
74S200	256x1 Static	6.95
4116N-4 (UPD416)	16K Dynamic 250ns (MM5290N-4)	2.95
4164N-3	64K Dynamic 200ns	19.95
MM2147J	4096x1 Fast 70ns	7.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.49
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	3.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	1.95
HM6116-4	16K (2Kx8) Static 200ns	14.95
82S25	64 Bit RAM (16x40C)	3.49
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	9.95
TMS4045	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	4.95
TMS2716	16K EPROM (-5V, +5V, +12V)	9.95
2716 Intel (2516) TI	16K EPROM (Single +5V)	8.95
2732 Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi HN462764)	49.95
5203	2048 PROM	14.95
82S23 (74S188)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123 (74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

— Over 30 More PROMS Listed in Our Catalog —

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM57499N	96/144-Key Serial Keyboard Encoder	8.95

RADIO CONTROL CIRCUITS

Ideal for remote control systems which use pulse amplitude modulation (toy cars, boats, tanks, etc.). Features: five function control, adjustable steering angle, suitable for 27 and 47MHz bands and low power consumption.

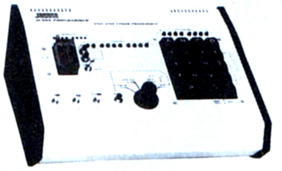
KB-4428 TRANSMITTER $4.25

Abs. max. rating (TA@25°C). Supply volt.: Vcc1 12VDC. Power Dissipation: PD: 300mW; Temp. range: Oper. 0— +50°C — Storage -30— +125°C. Recommended oper. volt.: 7-11V. Crystal or CR Oscillation circuits acceptable.

KB-4429 RECEIVER $5.95

Abs. max. rating (TA@25°C). Supply volt.: Vcc1: 11V. Vcc2: 7.5V. Power Dissipation: 600W. Temp. range: Oper. 0 ± 50°C. Recommended oper. volt.: VOP1 7-11V — VOP2 3-6V.

JE608 PROGRAMMER
2704/2708 EPROM PROGRAMMER



GENERAL APPLICATIONS:
- **To program EPROMS 2704 and 2708.**
- **Developmental system for microcomputer circuits**
- **To read the contents of a pre-programmed EPROM**
- **To compare EPROM(s) for content differences**
- **To emulate a programmed EPROM**
- **To store program in RAMS for alterations**
- **Three separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2^0-2^9) for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip. Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board. Rapid checking verification of programmed data changes. User may move data from a master to RAM's or write into RAM's with keyboard entries. Allows manual stepping manipulation (up and down) at any address location. Stand-alone EPROM Programmer consisting of: A 19-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W. Compact desk-top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¾"D. Weight: 5 lbs.**

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board w/25 IC's & includes power supplies of: -5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel board are separate assemblies within the system.

JE608K Kit $399.95
JE608A Assembled and Tested $499.95

JE608-16K ADAPTER BOARD
FOR 2716/2758 EPROMS

GENERAL DESCRIPTION:
The JE608-16K Adapter Board allows the JE608 Programmer to be modified for the additional programming of the 2716 and 2758 EPROMS. The adapter provides for adding an address switch for the 2^{11} bit and also for selecting the proper power and timing pulses to be applied to the EPROM. Programming and emulating the 2716 (16K) EPROM is done separately to each half (1024x8) of the EPROM because of the existing 8K RAM capacity in the JE608 Programmer.

JE608-16K	Adapter Board Kit	**$29.95**
JE608-Upgrade	(Send assembled JE608 to factory for adapter installation . . . . . . of the JE608-16K Adapter Board Kit)	**$99.95**
JE608A-16K Mod.	Assembled JE608 w/Adapter (JE608-16K) Installed	**$599.95**

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1.50 Insurance

Spec Sheets – 25¢
Send 86¢ Postage for your
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BOOKS
National Semiconductor – Intersil – Intel

30001	**National CMOS Data Book** . . . . (640 pages) 74C, CD4000, and A/D Converters	**$5.95**
30002	**National Interface Data Book** . . . . (704 pages) DP, DS8000, DS3600, DS75000, etc.	**$5.95**
30003	**National Linear Data Book** . . . . (1376 pages) LM, LF, ADC, DAC, LH Series	**$8.95**
30004	**National Series 80 – Board Level Computer (224 pages)** . . .	**$4.95**
30005	**National TTL Logic Data Book** . . . . (624 pages) 7400, LS, L, H, S, and DM8000 Series	**$8.95**
30006	**Buy above (3) 30001,3,5 as a set**	**$19.95/lot**
30009	**Intersil Data Book** (1074 pages)	**$6.95**
010400	**Intel Component Data Catalog** . . . . Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	**$10.00**
205610	**Intel Peripheral Design Handbook** . . . . Full data sheets, appl. notes for Intel peripheral device components (644 pages)	**$7.50**

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC1000	117V/60Hz	12 VAC 1 amp	$5.95
AC1700	117V/60Hz	9 VAC 1.7 amp	$3.95
DV 9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS

DB25P	**D-Subminiature Plug . . . .**	**$2.95**
DB25S	**D-Subminiature Socket . . . . .**	**$3.50**
D20418-2	**Screw Lock Hdwr. (2) DB25S/P**	**2/$.99**
DB51226	**Cover for DB25P/S . . . .**	**$1.75**
22/44SE	**P.C. Edge (22/44 Pin) . . . . . .**	**$2.95**
UG88/U	**BNC Plug . . . .**	**$1.79**
UG89/U	**BNC Jack . . . .**	**$3.79**
UG175/U	**UHF Adapter . . . .**	**$ .49**
SO239	**UHF Panel Recp. . . . .**	**$1.29**
PL258	**UHF Adapter . . . .**	**$1.60**
PL259	**UHF Plug . . . .**	**$1.60**
UG260/U	**BNC Plug . . . .**	**$1.79**
UG1094/U	**BNC Bulkhead Recp. . . . .**	**$1.29**

TRS-80
16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- ★ **8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)**
- ★ **Documentation for Conversion**

TRS-16K2	***150NS . . . .**	**$29.95**
TRS-16K3	***200NS . . . .**	**$24.95**
TRS-16K4	***250NS . . . .**	**$19.95**

JE610 ASCII Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (After assembled as pictured above) . . . **$124.95**

JE610 Kit 62-Key Keyboard, PC Board, & Components (no case). . . . . **$ 79.95**
K62 62-Key Keyboard (Keyboard only) . . . **$ 34.95**
DTE-AK (case only — 3¼"H×11"W×8¾"D) **$ 49.95**

NEW! JE212 – Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT
Provides -12VDC from incoming 5VDC . . **$9.95**

JE600
Hexadecimal Encoder Kit

FULL 8-BIT
LATCHED OUTPUT
19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

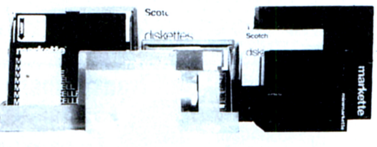
JE600/DTE-HK (After assembled as pictured above) **$99.95**

JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) . . **$59.95**
K19 19-Key Keyboard (Keyboard only) **$14.95**
DTE-HK (case only — 3½"H×8¼"W×8¾"D) **$44.95**

Circle 212 on inquiry card.

California Digital

Post Office Box 3097 B • Torrance, California 90503



DISKETTES

FREE PLASTIC LIBRARY CASE INCLUDED WITH THE PURCHASE OF EVERY BOX OF DISKETTES

Private labeled for California Digital by one of the most respected producers of magnetic media. Each diskette is certified double density at 40 tracks. To insure extended media life each diskette is manufactured with a reinforced hub-hole. And of course, a plastic library case is included with every box of diskettes. MMD-CD5(01)(10) Please specify computer or required sectors.

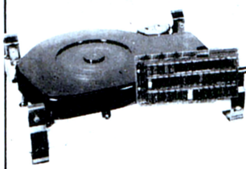
$24.95 BOX

Ten boxes $22.75 One hundred boxes $21.50

MINIDISKETTES	Box	10 boxes		Box	10 boxes
Memorex 3401	$27.00	$25.00	Scotch 744(0)(10)(16)	$31.00	$29.00
Verbatim 525(01)(10)	29.00	27.00	Dysan	45.00	43.00

EIGHT INCH	Scotch	box	10 bx.	Dysan	box	10 bx.	MRX	box	10 bx.
Single side/single den.	740-0	$35.	$33.	3740/1	$49.	$47.	3060	$ 5.	$ 3.
Single side/double den.	741-0	45.	43.	3740/1d	75.	73.	3090	37.	35.
Single side/32 sector	740-32	35.	33.	na.			na.		
Double side/ double D.	743-0	65.	59.	na.			3115	49.	45.

SCOTCH brand head cleaning kit. $24.95 MMA-CK(5)(8) please specify 5 1/4 8"
Prices available on request for: tape, cartridges, diskpacks, volumn diskettes.



26 Megabyte Hard Disk Drive from GEORGE MORROW'S Thinker Toys

$3495

Other Morrow Products.			
Additional hard disk	$3650	Disc Jockey 2D controller	$345
Discus 2D 1 drive	950	Disk Jockey 1 Controller	195
Discus 2D 2 drives	1627	M26 hard disk Controller	625
Discus 2+2 1 drive	1250	Switchboard interface	219
Discus 2+2 2 drives	2237	"New" Multiboard	275
		M-10 Ten Megabyte hard	2550

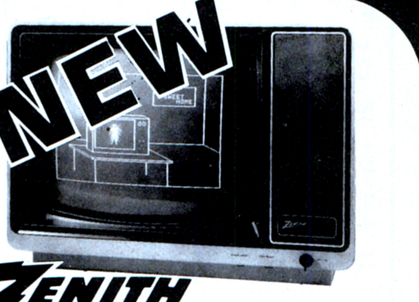
MEMOREX 8"DISKETTES $25

Recently the Memorex Corporation had a cancellation on a contract for a truck load of eight inch diskettes. California Digital was fortunate to be offered this load of prime magnetic media.

These diskettes are "UNBRANDED" but are guaranteed first quality Memorex Brand. (#3060 single den.)

Like all diskettes sold by California Digital, a library case is supplied free with the purchase of every box.

This offer is subject to remaining inventory on hand.



ZENITH GREEN PHOSPHOR MONITOR

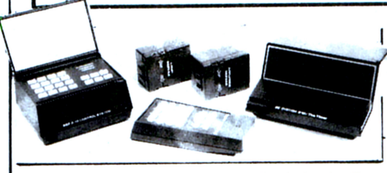
The new Zenith ZVM-121 features a P31 green phosphor tube along with 15 MHz bandwidth. Switch selectable for 40/80 character screen. Fully compatable with 80 column Apple cards.
VDM-Z131 20 lbs.

$119

10+ $109 100+ $99

MEMORY

64K DYNAMIC	16K STATIC
$11.95	$13.95
4164 100-$9.75	2167 200ns.
16K DYNAMIC	**2716 EPROM**
$2.10	$4.95
4116 100-$1.85	100-$4.50 1K-$4.00

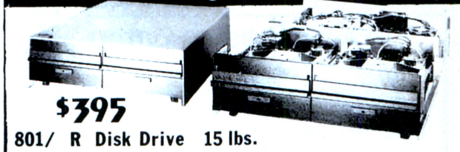


BSR SYSTEM X-10

The new BSR timer runs your home just like clockwork. Turns on lamps and appliances while your away from home. Completely compatible with your existing System X-10 devices.

BSR Timer eight channel	$65.00	Appliance Module 500 W.	$13.95
Master control console	34.95	Lamp Module 300 Watts	13.95
Ultrasonic Controller	19.95	NEW full control wall switch	14.50

Shugart Associates



$395

801/ R Disk Drive 15 lbs.

Shugart 801/R with CP 206 power supply, muffin exhaust fan, complete in dual enclosure with all the necessary harnessing cables. Documentation included. 36 pounds. MSD-1801 **$795**

Same as above but with two Shugart 801R disk drives. 50 pounds. MSD-2801 **$1195**

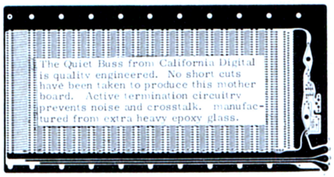
Disk drive cable. 6 feet 50 conductor with edge card connector at both ends. WCA-650S $25.00
Export Disk drives. 220V. 50MHz add $50.00 per disk drive.

2732 EPROM SALE $8.95

S-100 Mother Board $35

Quiet Buss™

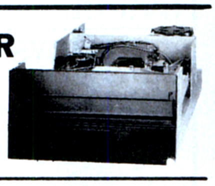
IMSAI 18 Slot CAL-M18



The Quiet Buss from California Digital is quality engineered. No short cuts have been taken to produce this mother board. Active termination circuitry prevents noise and crosstalk. manufactured from extra heavy epoxy glass.

SHUGART 801R

$395



STATIC

	ea.	32+	100+	1K+
21L02 450ns.	1.19	1.05	.99	
21L02 250ns	1.49	1.45	1.39	
2114L4 450ns	3.95	2.95	2.75	2.50
2114L3 300ns	4.25	3.75	3.00	2.75
4044-4 450ns	4.95	4.50	4.25	4.00
4044-2 250ns	5.50	4.95	4.50	4.35
5257-3 300ns	4.47	4.25	4.05	3.75

EPROM

2708 450ns	4.95	4.50	3.75	3.25
2716 5V.	4.95	4.50	4.00	
2716 tri-volt	9.95	9.00	8.25	7.50
2732 Intel	9.00	8.50	8.00	
2532 TI	21.50	19.00		
2764	*			

SWITCHES

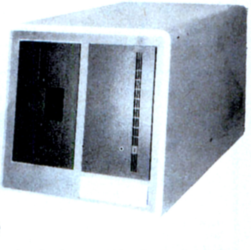
DIP SWITCHES

pos.	ea.	100+	1K+
4	.88	.75	.69
7	.99	.83	.79
8	1.05	.91	.87
12	1.19	.99	.91

TOGGLE

		ea.	100+
7101	on/on	1.19	.98
7103	on/off/on	1.39	1.19
7107	mnt. on	1.39	1.19
7108	mnt. on	1.39	1.19
7205	dpdt mnt	1.85	1.65

NEW from Shugart Technology 5 Megabyte Hard Disk Drive



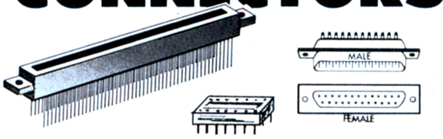
Packaged in the same physical size as the industry standard 5 1/4" minifloppy disk drive. The micro-Winchester stores thirty times as much data (6.38 megabytes unformatted), accesses data twice as fast (170 milliseconds) and transfers data twenty times faster (5.0 megabits per second.)

The ST506 is factory sealed to protect the media from environmental contaminates. Requires only DC voltage.

Dual California Digital 5 1/4" enclosure, ST506 drive and power supply. **$1500**

Shugart Associates SA400 removable media disk drive for above package. add: **$300**

CONNECTORS



GOLD EDGE CONNECTORS

S-100 .125" centers	each	10+
Imsai solder .250" row	$2.95	$2.50
Imsai wire wrap (TI)	3.95	3.50
Sullins Hi-Rel. .250"	4.50	4.00
Sullins Hi-Rel. W/W	5.35	4.90
Sullins /Altair .140"	4.95	4.50
.156" Centers (standard)		
22/44 Kim Eyelet	2.50	2.15
36/72 Digital Group S/T	5.95	5.50
36/72 Digital Group W/W	6.60	6.15
43/86 Motorola 6800 S/T	6.60	6.15
43/86 Moto. 6800 W/W	7.00	6.85

INTEGRATED CIRCUIT SOCKETS

	Low Profile		Wire Wrap	
	each	100+	each	100+
8 pin	$.10	$.09	$.46	$.41
14 pin	.10	.09	.45	.41
16 pin	.12	.11	.50	.45
18 pin	.15	.13	.68	.61
24 pin	.26	.24	.94	.87
40 pin	.42	.40	1.60	1.47

"D" Type	each	10-24	25+
DE9P male	$1.60	$1.40	$1.30
DE9S female	2.25	2.00	1.90
DE hood	1.50	1.35	1.20
DA15P male	2.35	2.15	2.00
DA15S female	3.25	3.10	2.90
DA hood 2/P	1.60	1.35	1.30
DB25P male	2.50	2.35	2.25
DB25S female	3.35	3.15	3.05
DB hood 2/P	1.35	1.15	1.05
DC37P male	4.20	4.00	3.70
DC37S female	6.00	5.75	5.50
DC hood 2/P	2.25	2.00	1.75
DD50P male	5.50	5.10	4.75
DD50S female	9.40	8.60	8.00
DD50 hood 2/P	2.60	2.40	2.10
CENTRONICS			
57-30360	7.95	6.75	5.75
RIBBON CABLE CONNECTORS			
17/34 5" disk	4.85	4.15	3.95
20/40 TRS-80	5.65	5.05	4.70
25/50 8" disk	5.90	5.15	4.90

Universal Data Systems

direct connect MODEM

Your Choice $169

Direct connect modems eliminate loss of information due to the carbon compression associated with acoustic modems. Choose either of these two great units.

The Universal Data Systems 103LP is switch selectable between answer and originate modes. Fully Bell 103 compatable. Directly connects to the new modular telephone jack. 100% powered from the telephone line. No need to locate modem in proximity to A.C. power recepticle. MOD-103LP 2 pounds.

Novation "D" Cat connects to most of the new "Bell" modular handsets. Ideal for multiple line office telephones. Requires external A.C. power. MOD-DCAT 2 Lb.

Universal Data Auto Answer 103LPJ $219
Novation Auto Cat RS232 $239

Regulated Power Supply 5 VOLT 5 AMP

$11.95

This USED surplus power supply was removed from working equipment. Pass transistor regulation outputs five volts at a conservative five amps. Suitable for TTL hobby applications. SPC-PS1 8 pounds.

Circle 60 on inquiry card.

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master charge THE INTERBANK CARD

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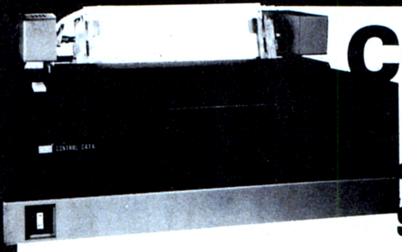


CONTROL DATA

CL416 MATRIX PRINTER

$1395

In a dark corner of a Control Data warehouse our scouts have recently located a small quantity of brand new, vintage 1978, Control Data CL-416 matrix printers.

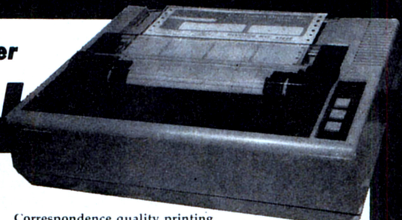
The CL-416 was designed for extra heavy duty industrial applications. Please do not confuse this work horse printer with the new low cost imports.

The unit prints a full 96 character ASCII set at a conservative 175 characters / second. One kilobyte buffer accepts RS232 signals upto 9600 baud. Vertical forms control unit provides added flexibility for business applications. The CL-416 has a split primary power transformer to allow field voltages between 115 and 230 volts.

Original cost of the printer is estimated at $5,000. California Digital blow out price is only $1,395. Shipped via motor freight in factory sealed containers. SPC-CL416

World's Best Selling Printer

EPSON MX80



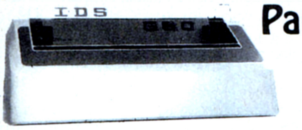
Immediate Delivery

Only $475

Correspondence quality printing.
A lot of printers costing a lot more can't touch the MX-80's performance. It gives you a choice of 40, 80, 66 or 132 columns of printing in as many as four distinct printing density modes, a total of twelve different combinations which can accommodate nearly any printing requirement.

Bidirectional printing. Logical seeking of shortest lines. 80 CPS. 64 graphics characters. Forms handling. The list of standard features goes on and on. The fact is that there are few printers that can compete with the MX-80 at ANY price. And none—ZERO—in its extraordinarily affordable price range.

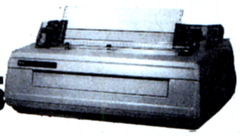
ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJ



Paper Tiger

560G

$1395

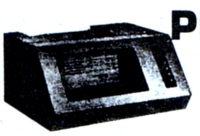


NEC Spinwriter

5510P/S

$2795

The word processing quality Spinwriter prints at speeds upto 55 characters per second. The Model 5510 P/S is supplied with both parallel and RS-232 serial interfacing. Also included is the tractor feed mechanism, along with print thimble and ribbon. PRN-5510PS 70 lbs. Keyboard (KSR) Model 5520 P/S available $2995. PRN-5520PS 75 lbs.



PRINTRONIX

P-300 $4500

P-600 $6150

PRINTERS

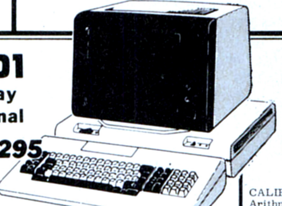
Epson MX80	PREMX80	$475
Epson MX80FT	PREMX80F	595
Epson MX100	PREMX100	825
Anadex 9500	PRA9500	1295
Anadex 9501	PRA9501	1295
Anacom 150	PRA150	1075
IDS Paper Tgr.	PRG460G	1095
IDS Tiger 560	PRG560G	1350
Diablo 630	PRD630	2150
Diablo 1650	PRD1650	2850
Diablo 1640	PRD1640	2496
Datasouth 180	PRD180	1350
Printronix 300	PRP300	4500
Printronix 600	PRP600	6150
NEC/Sellum 1	PRN5510ps	2695
NEC/Sm 16K	PRN5516ps	2795
TEC/Starwrit.	PRV300	1395
Okidata 80	PRO80	419
Okidata 82	PRO82	619
Okidata 83	PRO83	895
Teletype 43K	PTT4320K	1095
Texas Ins. 810	PRT810B	1450
Tex. Ins 810C	PRT810C	1795
Centronics 730	PRC730P	529
Centronics 737	PRC737P	695
Centronics 739	PRC739P	795
Centrnx 704-9	PRC704-9	
Centrnx.704-11	PRC704-11	

SYSTEMS

APPLE II 48K MEMORY $1150

$2550 HEWLETT PACKARD HP85

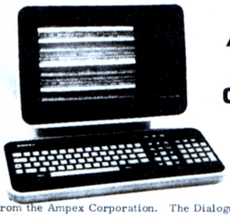
Hew/Pack 85	SYSHP85	2650
Hew/Pack 83	SYSHP83	1895
Altos ACS8000	SYSACS8000	4795
Osborne 1	SYSOB1	1795
Commodore	SYSC8032	1495
Commodore	SYSC8096	1795
Superbrain64Q	SYSSB64Q	$3350
Superbrain64D	SYSSB64D	2850
Northstar 64Q	SYSN64Q	3295
Northstar 64D	SYSN64D	2895
NEC/PC8000	SYSPC8000	call
Apple II Plus	SYSAP	1170



IBM 3101 Display Terminal

IBM Direct Price $1295

California Digital discount price $1195



AMPEX DIALOGUE 80 CRT TERMINAL

$995

New from the Ampex Corporation. The Dialogue 80 features removable keyboard, displayable two pages (four optional) dual program keys, half intensity protected fields and status line. Transmits data either block, line or character mode. Excellent value. VDT-D80 shipping 47 lbs.

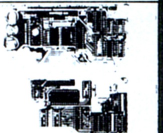
VIDEO TERMINALS

ADDS Viewpoint	VDT-RVP	595
ADDS Regent 25 numeric cluster	VDT-R25	850
ADDS Regent 30 25th status line	VDT-R30	950
ADDS Regent 40 limited graphics	VDT-R40	1195
ADDS Regent 60 Block mode	VDT-R60	1495
Ampex Dialouge 80 two page,detatch	VDT-D80	995
Digital Equipment VT-100	VDT-V100	1595
Digital Equipment VT-132	VDT-V132	1895
Direct VP-800A emulator	VDT-P800	call
Hazeltine 1410	VDT-H1410	750
Hazeltine 1420	VDT-H1420	795
Hazeltine 1500	VDT-H1500	
Hazeltine 1510	VDT-H1510	
Hazeltine 1520	VDT-H1520	
Hewlett Packard 2621A	VDT-HP21A	
Hewlett Packard 2621P	VDT-HP21P	
IBM 3101-10 character mode green	VDT-3101	1195
IBM 3101-20 block mode	VDT-31012	1395
Lear Seigler 3A upper case only	VDT-L3A	850
Lear Seigler ADM5	VDT-L5	945
Lear Seigler ADM31	VDT-L31	1385
Lear Seigler ADM42	VDT-L42	1995
Visual 200	VDT-V200	995
Televideo 910C (new)	VDT-T910	595
Televideo 912C	VDT-T912	665
Televideo 920C	VDT-T920	745
Televideo 950C detatchable keybd.	VDT-T950	985
Zenith Z-19	VDT-Z-19	735

VIDEO MONITORS

BMC KG12C 18MHz P-31 grn phosphor	$259
Leedex/Amdek 12"100	129
Leedex 100 green	169
Leedex 100-80	197
Hitachi color 13"	389
Zenith color 13"	379
NEC green phosphor	219
Panasonic color 10"	
Sanyo 9" BW	149
Sanyo 12" green phos.	235
Sanyo 15" BW	259
Sanyo 13" color	419

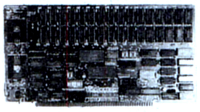
ACCESSORIES FOR THE APPLE COMPUTER

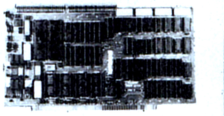


CALIFORNIA COMPUTER SYSTEMS	
Arithmetic Processor 7811 B/C	$319
Asynchronous serial interface 7710	129
Centronics Interface card 7728	95
12K PROM Module 7114	69
Calender/Clock, Bat. back-up 7424	99
Parallel Interface 7720A	99
Programable Timer 7740A	99
Analog/Digital converter 7470A	99
MICROSOFT PRODUCTS	
Apple to Z-80 CPU card	379
D. C. HAYES PRODUCTS	
Micromodem for Apple	319
COMPUTER STOP PRODUCTS	
Double Vision / 80 Column Video	250
INTERACTIVE STRUCTURES	
16 Channel A/D card AIO/2	275
MOUNTAIN COMPUTER PRODUCTS	
Intro X-10 system for BSR	$239
Intro X-10 card only	165
16 channel AD/DA 8 bit	319
Apple Clock battery back-up	225
Supertalker SD200	245
ROM Plus with filter	165
ROM Writer/Programmer	149
APPLE BRAND PRODUCTS	
Apple Language card	450
Floppy disk with controller	560
Floppy disk without controller	495
Apple parallel interface	175
SSM MICROCOMPUTER	
Dual serial parallel interface AIO	
SORRENTO VALLEY ASSOCIATES	
8" floppy controller (Pascal)	360

S-100 BOARDS

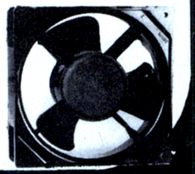
Assembled • Tested • Burned-in





CPU BOARDS		
Calif. Computer 2810A Z-80 DMA, 4MHz	BDC-C2810	$250
Godbout Z-80 24 bit, 4MHz	BDC-GZ80	239
Godbout 8085/8088 dual 16 bit processor	BDC-G88	375
Measurement Systems Z-80 4 serial 2 parallel real time clock, 8 vector	BDC-MZ80	395
SD Systems SBC-200 Z-80 with serial & parallel I/O ports	BDC-SBC2	385
Teletek FDC-1 single board CPU & floppy disk controller plus I/O	BDC-FDC1	695
MAINFRAMES		
Calif. Computer 2200A 12 slot & power supply	ENM-C2200	349
TEI 12 slot table	ENM-T12	
TEI 22 slot table	ENM-T22	650
Godbout mainfrm.	ENM-GMF	
MEMORY BOARDS		
Calif. Computer 2065A 64K dyamic memory	BDM-C2065	$429
Calif. Computer 2016 16K static memory	BDM-C2016	259
Calif. Computer 2032 32K static memory	BDM-C2032	585
Godbout Ram 17 64K static memory 16 bit	BDM-G17	1025
SD Systems Expandoram II 16K dynamic	BDM-EX16	295
64K dynamic	BDM-EX64	375
Measurement Systems DMB6400 for Alpha Micro	BDM-M6400	685
EPROM BOARDS		
Digital Research 32K, 2716 proms extra	BDM-DP32	99
SD Systems Prom-100 programmer	BDM-P100	250
FLOPPY DISK CONTROLLER		
Calif. Computer 2422A with 2.2 CPM	BDF-C2422	329
Godbout "Disk One" features the NEC 765 controller, DMA arbitration	BDF-GD1	395
Measurement Systems 765 chip, single & double density. Error recovery	BDF-MF	419
SD Systems Versafloppy II double density	BDF-VF2	419
Tarbell D/D	BDF-TF2	419
Morrow Design Disk Jockey I single density	BDF-DJ1	195
Morrow Design Disk Jockey II double density	BDF-DJ2	345
INTERFACE BOARDS		
Calif. Computer 2718 I/O 2 serial/2 par'l	BDT-C2718	
Morrow Designs Switchboard 2 serial/4 par'l	BDT-MSB	219
Morrow Designs Multiboard 3 serial/3P. +++	BDT-MMB	275
Godbout Interfacer One 2 serial/2 par'l	BDS-GB1	199
Godbout Interfacer Two 1 serial/3 par'l	BDS-GB2	199
SPECIALITY BOARDS		
QT Computer real time clock/calendar	BDS-QCK	135
Artec Elec. Wire wrap prototype board	BDS-AWW	25
Artec Elec. General Purpose proto board	BDS-AGP	25
Godbout Spectrum color board	BDS-GSC	295
D. C. Hayes S-100 Micromodem	BDS-HM1	350
Mullen Products extender board & logic probe kt	BDS-MTB1	49
Mullen Products Opto-contro board kit	BDS-MOC	139

Rotron Muffin Fan



$14.77

$12.00 @ 100
10.50 @ 1000

115 VAC. 7 Watts WR2A1
Factory fresh Muffin fans
NOT pull-outs. EMF-4M

VISA

master charge

All merchandise sold by California Digital is premium grade.
Shipping: First five pounds $2.00; each additional add $.40
Foreign orders 10% shipping. Excess will be refunded.
California residents add 6% sales tax. COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet."
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TECHNICAL & CALIFORNIA
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Unclassified Ads

FOR SALE: Technico Super Starter System (9900 processor) with schematic. SwTPC keyboard, Phi-Deck variable speed, control board, remote-control box, digital head, and power supply. Full documentation on them all. Looking for Sinclair ZX80 or PET (trade?). Paul Bergson, 1413 N 11th St, Superior WI 54880, (715) 394-3101.

WANTED: TRS-80 Model II with read-only memory, expansion interface, disk drive(s), etc. R J Carlson, 1210 46 Ave, Meridian MS 39301, (601) 483-2459.

FOR SALE: Xerox 1730 (Diablo 6630) letter-quality printer with adjustable forms tractor and Televideo 912C video display. Both five months old and used only for a brief testing period. $2750 or best offer. Steven Gelles, 112-41 72 Rd, Forest Hills NY 11375, (212) 544-7030 evenings.

FOR SALE: TRS-80 16 K Level II: all components (processor, monitor, cassette, power supply, cables), line filter, manuals, over thirty programs (EDTASM, games, utilities), and books and magazines related to TRS-80s. All in perfect condition (original Radio Shack seal intact). Original value over $1000, sacrifice for $600 plus shipping. Albert M Berg, 1914 Ave O, Brooklyn NY 11230, (212) 645-2397.

WANTED: Documentation for Processor Technology NKRA 64 K dynamic programmable-memory board. I need assembly instructions, schematic, and parts list. Please send a copy or I can copy and return your original. Michael Schirpke, 8 Champa Rd, Billerica MA 01821.

FOR SALE: 1802 system, including Netronics 4 K programmable memory, Giant Board, processor board, 1702 and 2708 EPROM board, SN76477N music board, two A-Ds, five extra I/Os, Hex-Dec decoder, address display, and processor status. Software includes CHIP-8, T BASIC, plus material from RCA, Quest, and Netronics. All for $300. T Constable, 130E 24th St, New York NY 10010, (212) 533-5163 evenings.

WANTED: College student interested in computer experimentation. Due to limited funds, I would like information concerning used or discarded computer equipment and/or parts. If you have such, please send me your name and address with a list of the equipment. John M Hall, 1445 Royalwyn Dr, Box 602 LWW, Macon GA 31210.

FOR SALE: Over 1000 boards from IBM System 1140 computer. All with gold-plated edge-connector pads. All boards loaded with parts. Other miscellaneous parts include edge connectors and card guides. Offers? Ken Cazakoff, RR #2, Bedford Rd, Nelson British Columbia, V1L 5P5 Canada, (604) 352-3898.

FOR SALE: Compucolor II Model 4 computer with 103-key keyboard. Cost $2000, will sell for $1300. Also, Olivetti teleprinter for $300. Robert Meader, 17721 140 NE, Woodinville WA 98072, (206) 483-8600 days.

FOR SALE: SwTPC 6800 processor board, motherboard, 4 K programmable-memory board, 16 K programmable-memory board, MP-C serial board, parallel board, ACIA board, front-panel display, MIKBUG monitor, TSC BASIC, and Siemens 5-inch floppy disk. $750, you pay UPS. Will ship COD. Steve Griffith, POB 791, Safford AZ 85546.

FOR SALE: OSI C4P-DMF computer with 48 K programmable memory and dual minifloppies. Includes color monitor, printer, modem, and joysticks. Includes the following languages: BASIC, Pascal, FORTRAN, FORTH, and assembly. Extensive documentation and over 200 software programs. Excellent condition. Cost almost $6000, sell for $2000. Kevin Mucha, 10445 W Kiehnau Ave, Milwaukee WI 53224, (414) 353-3683.

FOR SALE: 1-megabyte hard-disk drive with documentation and interface information. First $350 takes it. I pay shipping. KSR35 ASCII Teletype. Excellent hard copy for Apple, TRS-80, etc. $300 plus shipping. Would like to buy the following: Cromemco Z-2 system, 64 K S-100 memory board with 16 K or less memory, I/O Selectric Heuristics Speechlab, Computalker speech-synthesis board. All letters answered same day. Fred Aker, Farmers Way, Carlsbad Springs Ontario, K0A 1K0 Canada, (613) 822-1443.

FOR SALE: TRS-80 Model I, Level I computer with 4 K programmable memory. Includes video screen and recorder. In very good condition. Comes with books, manual, software, and graphics sheets. Am asking $325 and will pay shipping cost anywhere in the continental US. Ron Campbell, 412 Woodley Rd, Savannah GA 31406, (912) 925-6524.

FOR SALE: New Intel SBC 86/12A 16-bit, single-board computer with 32 K dynamic programmable memory, RS-232 serial port, three parallel data ports, PIC, and interval timer. Also includes schematics and documentation. List $2600. Asking $1300 or best offer. Helmars Ozolins, 59 Hagerman Landing Rd, Rocky Point NY 11778, (516) 744-4204 after 6.

FOR SALE: Cleaned out ham/computer/electronics shack. Have two-page list of amateur radio equipment, automotive electronics, tools, scanner, paraphernalia; you name it, it might be there. All items for sale or trade, and purchasing list is included. SASE would be appreciated. Dave Miller, POB 9684, Birmingham AL 35215.

FOR SALE: 8 K PET with joystick, light pen, sound, RS-232 output, and seventy cassettes; $900. First ten issues of BYTE; $15. Bruce Beebe, 2580 E 2100 South, Salt Lake City UT 84109, (801) 584-1287.

WANTED: Schematic and parts list for a SEAL 32 K SC memory bare board. Will pay reasonable reproduction costs plus postage. G S Meader, Jr, 1601 Greenbrier Ct, Reston VA 22090.

WANTED: The MEI (Merlin Extended Intelligence) read-only memory and manual for the Mini Term Associates Merlin Board. I need a listing of the software, the instruction manual for the software, and the 8316 mask read-only memory or a 2716 with the software or a Tarbell formatted cassette with the software. Dave Lamb, 3501 Kingston Cir, Ft Collins CO 80525, (303) 223-7131 collect.

FOR SALE: Expandor Black Box (Mite) printer: 80-column, 10 cps, parallel I/F, friction/pin feed, and uses teletypewriter ribbons. Has seen light service, in very good condition. Runs on Sphere and TRS-80 processors. Manual included. Cost $450, asking $250. Chuck, (303) 986-9027 after 7 PM MT.

FOR SALE: Complete set of *Popular Electronics* from first issue (1954) to 1980; $200. Also, various model-aircraft magazines, and assorted *Scientific Americans*. Send for full list. Bill Schweber, JAFFA Engineering, POB 543, Sharon MA 02067.

WANTED: Back issues of *OMNI* magazine in mint condition. William Blair III, 909 E Emerson, Morton IL 61550.

FOR SALE: H-8 computer, one year old. Recently configured for O-origin CP/M 2.2. Includes H-17 dual disk drive and controller card, Trionyx 64 K memory, and WH 8-4 4-port interface equipped with three RS-232 rear-panel D connectors. Complete documentation and $600 worth of software, including CP/M 2.2, MAC, SID, FORTRAN 80, and space game. Best offer will be accepted and will ship at no charge anywhere in the US. Dennis Crouse, 125 Conant Rd, Melrose MA 02176, (617) 964-8360 between 9 AM and 5 PM, call collect.

FOR SALE: Heathkit ET-3400 microprocessor trainer, ETA-3400 interface, and EE-3401 training course. Expertly constructed. Make offer. Doug DePrenger, 7800 Mockingbird Ln #139, Ft Worth TX 76180, (817) 485-2904 evenings.

COLOR PROGRAMS: Games, applications, and educational programs on cassette for the TRS-80 Color computer. Will trade for other original programs (or homebrew hardware designs) for the same machine. Send tape or information with your address and I will send my programs by return airmail. S W Li, 154 Curzon St, Toronto Ontario, M4M 3B5 Canada.

FOR SALE: KIM single-board computer, George Risk keyboard, and XITEX SCT-100 terminal board with power supply plus video monitor. Package includes documentation for keyboard, terminal board, and monitor. Also included are several KIM manuals. Everything works perfectly. $600 package, first offer over $250 takes it. Sue Livingston, 601 Pinchot Ave, Madison WI 53716, (608) 221-8431 evenings.

FOR SALE: S-100 boards removed from operating system. Documentation and shipping included. Ithaca Audio Z80 processor board, 4 MHz without read-only memory; $150. WMC FPB-1 front-panel board; $100. DRC 8 K 200 ns static programmable-memory board; $100. Electronic Systems TIDMA with system-monitor cassette; $80. California Digital motherboard with eight connectors installed; $45. Sunny International T3 transformer with capacitors; $40. WMC IOB-1, 2P + 1S ports bare board; $20. BYTE issues 1, 2, 3; best offer. John Fliegel, 112 Timberwood Dr, Mars PA 16046.

FOR SALE: TI-99/4 computer in excellent condition, with joysticks, tape recorder, large program library, light pen, three command modules, 16 K programmable memory, and 24 K read-only memory. $699 or make offer. David Rockower, (714) 456-0861.

FOR SALE: QT SBC + 2/4 processor board; $150 or best offer. TV interface from Electronic Systems part #107A; $10. Both boards are assembled and include complete documentation. Stephen Belisle, 701 Cavu Rd, Georgetown TX 78626, (512) 863-6205.

WANTED: Prisoner wants to write to pen pals with shared interests: computers, digital electronics, calculus, and Fibonacci numbers. Please use SASE. Kearney, B-88913, San Quentin CA 94974.

FOR SALE: California Computer Systems parallel interface Model 7720B, complete with cable and sockets for interfacing between an Apple II and an IDS 460 printer. I could not figure out how to write software patches to allow the interface to run the printer. The hardware is in mint condition. $80 will deliver the items plus manual. John Kundrat, 1622 21st St, Lewiston ID 83501, (208) 746-3487.

FOR SALE: Heath H-8/48 K (16 Trionyx, 32 Heath) 4-port and H8-5 serial with dual Heath cassette. H-9 video display with 24 lines uppercase/lowercase. All for $888. Also, WH-14 printer; $555. R Jackson, 201 Mortimer Ave, Rutherford NJ 07070, (201) 939-2421.

WANTED: Original IMSAI 8080 system. Looking for mainframe with at least six connectors, 28 A power supply, original front panel, MPU-A 8080 processor board, SIO 2-2 interface board, approximately 16 K of memory, and all necessary documentation. Keith Headley, 1161 Statler St, San Pedro CA 90731.

FOR SALE: DC 300A tape cartridges. I have six, mixed brands, that were used for archival storage. I have no way of checking them, but all should be good. Make offer for all six, if you don't get at least three good ones, refund guaranteed. A W Du Rea, 101 Indian Ln, Oak Ridge TN 37830.

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Ciarcia Controls August BOMB

Steve Ciarcia cops first place again with the second part of his article, "Build a Z8-Based Control Computer with BASIC." Steve will, of course, receive the $100 purse. Second place goes to Stan Miastkowski for his report on "The Japanese Computer Invasion." (As a staff member, he is not eligible for the $50 prize.) Third place goes to Adele Goldberg for her article, "Introducing the Smalltalk-80 System," an overview of the theme of BYTE's annual language issue.

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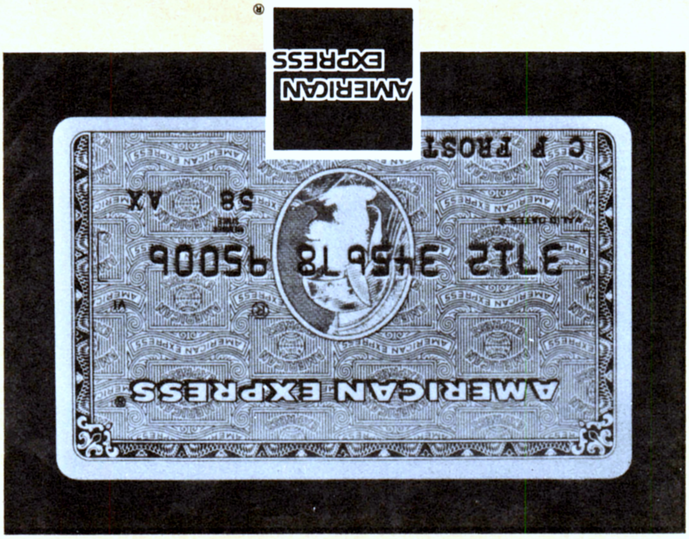
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Your Personal Data

First, Middle, Last Name

Date of Birth | Number of Dependents | Social Security Number

Your Home Address—Personal Reference

Street Address

City, State and Zip Code

Home Phone (Area Code) | Years There | Own Home ☐ Rent ☐

Previous Home Address | Years There

City, State and Zip Code

Nearest Relative or Friend Not Living With You | Relationship

Street Address

City, State and Zip Code

Your Job

Employer or Firm Name

Nature of Business

Position | Years There

Street Address

City, State and Zip Code

Business Phone (Area Code) | Self-Employed ☐

If Employed By Above Less Than 3 Years: Previous Employer or College/University | Years with Firm or Graduation Date

Street Address

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Your Income

Your Annual Earnings

If there are other sources of income you would like us to consider, please list the income, source and person (Banker, Broker, Employer, etc.) to whom we can write for confirmation. (Alimony, separate maintenance or child support need not be revealed if you do not wish to rely on it.)

Amount | Source

Name

Address

Credit References

List Credit Cards | Account Number

Other Credit Reference

Bank (Company Accounts Show Company Banks)

Bank Address, Street

City, State, Zip Code

Type of Account | Account Number

Bank (Company Accounts Show Company Banks)

Bank Address, Street

City, State, Zip Code

Type of Account | Account Number

Type of Account Wanted

☐ Personal Account ☐ Company Account Bill to: ☐ Home ☐ Office

Billing Address

City, State, Zip Code

Additional Cards–Personal Accounts

For only $20 a year (in addition to your Basic membership fee), you can obtain American Express Cards for qualified members of your household or your dependents. They must be at least 18 years of age. Each agrees, by signing below, to the exchange of credit information about them and the same agreement printed above the basic applicant's signature.

First, Middle, Last Name

Street Address

City, State and Zip Code

Social Security Number

Signature of Supplementary Applicant

Print your name below as it should appear. Spell last name completely. Full name must not exceed 20 spaces.

044-00-0045-3

FOLD▸

AN APPLICANT, IF MARRIED, MAY APPLY FOR A SEPARATE ACCOUNT.

By signing below, I ask that an account be opened for me and Card(s) issued as I request, and that you renew and replace them until I cancel. I understand that you may verify and exchange information on me and any additional applicants, including requesting reports from credit reporting agencies. I am aware that this information is used to determine my eligibility for the Card and that, if my application is approved, you may contact these sources to update this information at any time. If I ask whether or not a credit report was requested, you will tell me, and if you received a report, you will give me the name and address of the agency that furnished it. I will be bound by the Agreement received with each Card, unless I cut the Card in half and return both halves to you. If this is a personal account, I agree, or if this is a company account, both I and the company agree, to be liable for all charges to the basic and additional Cards issued on my request. And each additional Cardmember will be bound by the Agreement received with the Card and will be liable for all charges to that Card.

Signature of Applicant | Date

X

For Company Account, Signature of Authorizing Officer Required | Title

X

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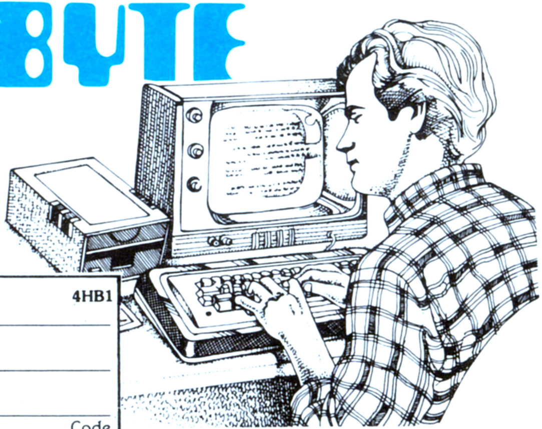

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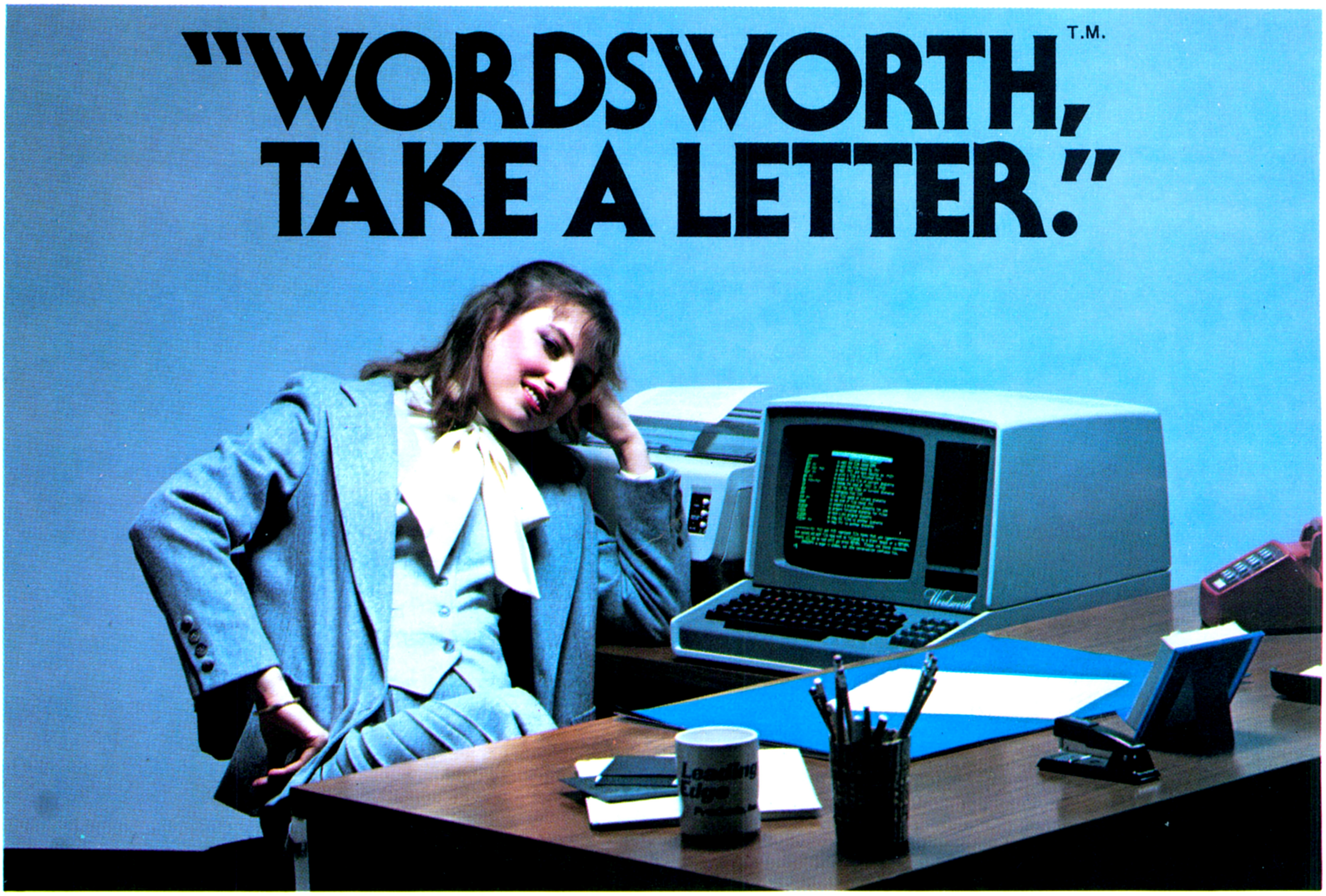

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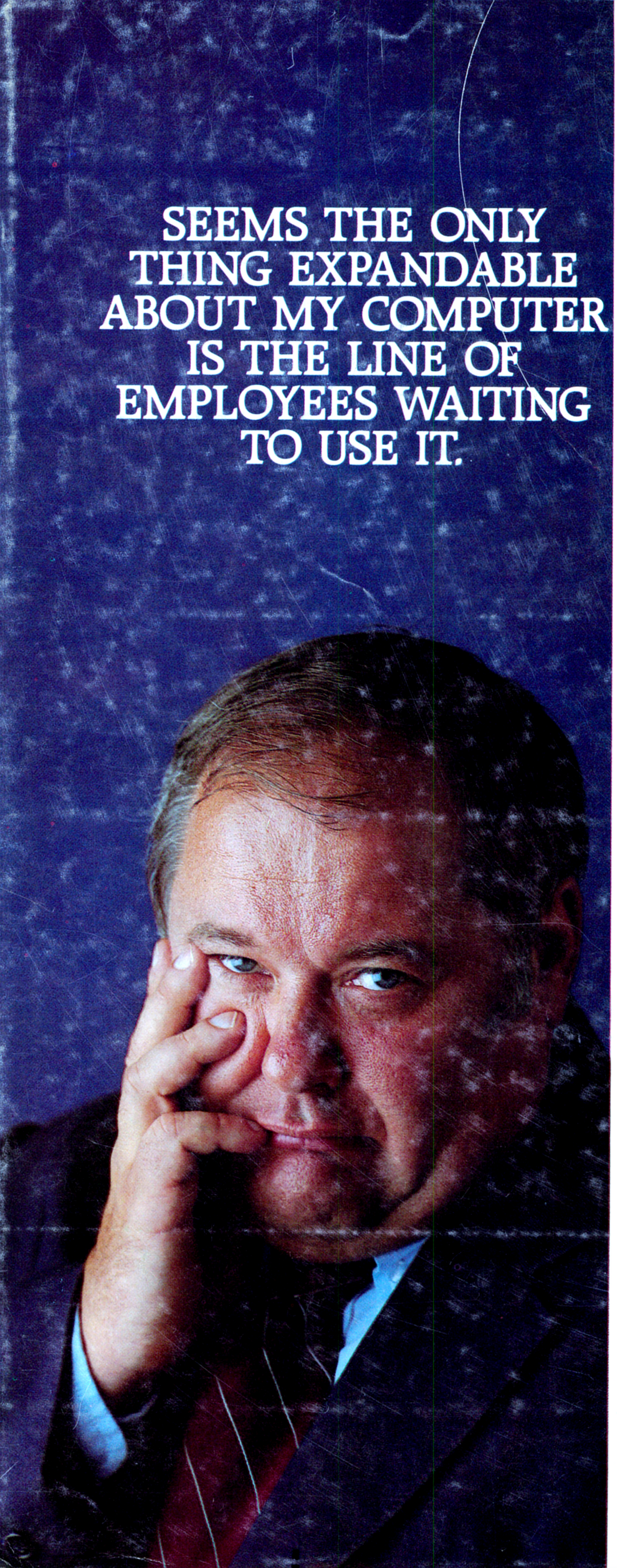

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